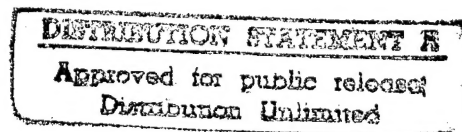




# Industrial Assessment for the Meal, Ready-to-Eat (MRE)

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## **PREFACE AND ACKNOWLEDGMENTS**

Victory in the Cold War era has brought significant changes to the defense industry. Since the peak year in 1985, total defense procurement has declined by 67 percent in real terms. Defense suppliers have responded to these cuts in predictable ways. Factories have been restructured, reduced, or closed. Skilled personnel have been laid off. Some firms have merged or restructured; others have abandoned defense production entirely. Because these changes could have important consequences for the Department's ability to meet its future mission requirements, we are analyzing the effects of these changes in selected industrial sectors. This report describes the results of one of those studies — the Department's assessment of the Meal, Ready-to-Eat (MRE) industry.

This assessment was prepared under the direction of Mr. John Goodman, Deputy Assistant Secretary of Defense for Industrial Affairs. It was led by Mr. Martin Meth, Director, Industrial Capabilities and Assessment, Office of the Secretary of Defense; and Mr. Chester Kowalczyk, U.S. Army Assistant Director for Energy and Troop Support. Representatives from the Office of the Secretary of Defense, Army, Marine Corps, and Defense Logistics Agency formed the nucleus of the team that researched and wrote the assessment. The Department would like to acknowledge the contributions of Mr. Gary Powell, who served as the assessment coordinator; Lieutenant Colonel Carol Kornhoff, USA, who was the assessment focal point; Major Leonardo Manning, USAF, Major Mary Whitworth, USA, Captain Glenn Hall, USMC, Ms. P.J. Carr; Ms. Nancy Chester, and Mr. Richard Cromley, who served as primary technical advisors; Colonel Patrick Egan, USAF, Lieutenant Colonel Charles Cone, USMC, and Ms. Genie Wagner, USN, for their respective Services' input; and Mr. William L. Hand, Logistics Management Institute, and Mr. Ellis Speed, who served as the report's editors.

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We welcome comments on this report. Please address them to Mr. John Goodman, Deputy Assistant Secretary of Defense (Industrial Affairs), 3300 Defense Pentagon, Washington, DC 20301-3300.

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## **EXECUTIVE SUMMARY**

The Meal, Ready-to-Eat (MRE) is the Department of Defense's (DoD's) "go to war" ration designed to provide individual meals to troops in austere environments. The actual MRE ration has virtually no commercial market counterpart, since commercial products do not meet the stringent military nutrient, shelf life, and packing requirements. About half of the components in an MRE, however, do consist of commercially-developed food components. DoD must therefore retain sufficient industrial capability to meet its requirements. We are employing innovative acquisition and business practices to help lower the cost of MREs. These innovative practices will maintain effective competition, encourage MRE supplier diversification into commercial markets, and fund new technologies to improve production efficiency and response times. As a result, MRE industry production capabilities are, and are expected to remain for the foreseeable future, sufficient to meet both projected peacetime and mobilization requirements.

### **MRE Requirements**

The MRE is an individually packaged and nutritious, ready-to-eat meal that can be eaten hot or cold, and is designed to be used in austere environments when no supporting cooks or group rations can be provided. The MRE components are a mix of military-unique and commercial formulations.

MRE design characteristics are based on an operational requirements document and subsequent mission needs statements. MREs must have an extended shelf life (a minimum of three years at 80 °F) so that war reserve stocks can be prepositioned to minimize transportation delays and supply the deployed force until production can be surged to meet wartime demand. MREs are packaged in flexible pouches compatible with field clothing pockets. MRE weight and volume are minimized to ease the burden on troops, and reduce the number of aircraft and ships required for transport. Additionally, MREs must meet nutritional requirements more stringent than those required for commercial products, and must be nutritionally acceptable for consumption up to 21 days as a sole

diet. Finally, MREs must be assembled and packed to survive rough handling and air delivery — with or without parachutes.

DoD requirements represent virtually all MRE demand. In peacetime, MREs are purchased in sufficient quantities to feed military combat personnel during training and contingency operations, and to store as war reserve stocks in various parts of the world. The war reserve stocks are periodically rotated to meet peacetime feeding needs and to maintain adequate quality. During the first 60 days of mobilization, war reserve stocks are used almost exclusively until the MRE industry can surge production to meet wartime (mobilization) requirements.

Every military branch uses MREs. The Army and the Marine Corps are the largest customers. DoD's demand for MREs is influenced by training requirements, the rotation of war reserve rations, and peacetime military operations. The Defense Personnel Support Center (DPSC) is currently in the third year of a three-year program to purchase a total of 5.28 million cases of MREs. Annual MRE procurement levels are projected to stabilize at about 2.1 million cases for the next several years (\$109.3 million in FY95). Foreign military sales of MREs have increased from \$375,000 in FY90 to \$5.1 million in FY95. The industry also provides similar rations to DoD in the form of Humanitarian Daily Rations (HDRs) and Humanitarian Pouched Meals (HPMs). Although these products have a different nutritional content than MREs, they rely on the same manufacturing techniques.

The actual MRE ration has virtually no commercial market counterpart, since commercial products do not meet the military nutrient, packaging, and packing requirements. However, since 1989 MREs have contained commercial products. About half of the components in an MRE are commercial components. Although the MRE has no commercial counterpart, the processes used to produce MREs are virtually identical to those used to process commercial products.

## **MRE Producers**

The MRE industry comprises four types of primary suppliers. Retorters (six firms) process raw food ingredients into either entrees, fruits, or starches, and then seal them in flexible, preformed pouches. Bakers (two firms) provide shelf-stable cakes, cookies, brownies, and breads specially

formulated to meet military nutritional requirements. Support component suppliers (21 firms) furnish candy, beverages, hot sauce, crackers, jelly, cheese, and peanut butter spreads. Assemblers (three firms) package the components into a meal bag according to a menu plan, and pack the meal bags into shipping cases that are palletized for shipment.

Key subtier suppliers include packaging firms (six firms) and raw food suppliers (numerous firms). Packaging firms provide preformed pouches to the retorters, and material for support components, accessory bags, meal bags, and shipping cases to the assemblers. Raw food suppliers provide food items such as uncooked meats, vegetables, spices, and starches to the retorters and bakers.

MRE retort, bakery, and assembly firm profitability has declined from that experienced during the peak demand of Operation Desert Storm in 1991. Despite decreasing military sales, retort and assembly firm profitability continues to be comparable to commercial firms in similar businesses. Bakery firms are experiencing lower profitability than their commercial counterparts. DPSC is monitoring the bakery suppliers to ensure required production capabilities continue to be available. DoD sales account for the majority of the business for these firms. The Department did not analyze the financial performance of the support component, packaging material, and raw food suppliers because they are primarily commercial firms with very limited military sales.

## **Capabilities Meet DoD Requirements**

DoD MRE procurements, policies, and actions sustain sufficient production capacity to meet the Joint Chiefs of Staff troop mobilization requirements, provided war reserve levels are maintained at existing levels. Current mobilization requirements, based on two nearly simultaneous major regional contingencies, are 9.35 million cases of MREs — sufficient to feed 614,000 personnel — across 150 days. In the first 60 days DoD projects that 4.9 million cases will be consumed. Therefore, the Department maintains a war reserve level of 4.6 million cases to allow for industry to ramp up production.



Industrial capabilities needed to meet peacetime defense requirements for MREs are substantially less than those required to meet mobilization requirements. Ongoing and planned MRE acquisitions, coupled with the Department's actions to meet mobilization requirements, are adequate to sustain the industrial capabilities to meet peacetime requirements.

Between 1996 and 2000, the Department plans to spend about \$22 million on DoD food program research and development efforts. DoD food program research and development efforts include: (1) advancing performance enhancement and nutritional technologies to increase the Service Member's mental acuity, improve physical performance, reduce battlefield stress, and extend mission endurance; (2) developing preservation and stabilization technologies to improve the stability of rations to withstand the rigors of long-term military storage and distribution worldwide; and (3) exploring innovative food processing technologies to expand the variety of components which can be incorporated into rations. Under the overall direction of the U.S. Army Soldier Systems Command (SSCOM) Natick Research, Development and Engineering Center (NRDEC), the Department is coordinating research activities with other government agencies, industry, and academia. Approximately \$3 million of the total is focused on improving the MRE and reducing cost. The technology improvement programs, while required to meet evolving operational and doctrinal requirements, also sustain sufficient scientific and engineering capabilities in food technology to meet Department requirements for the foreseeable future.

## **MRE Acquisition Strategies and Business Practices**

DPSC is employing innovative acquisition strategies and business practices to help lower the cost of MREs. These are designed to increase contractor efficiency and economies of scale, maintain effective competition, encourage MRE supplier diversification into commercial markets, and fund new technologies to improve peacetime production efficiency and response times. Since its introduction in 1980, the price for an MRE has decreased by 22 percent in real terms — despite improvements in acceptability, nutrition, and durability.

Today's MRE acquisition environment is characterized by increasing fiscal constraints, declining peacetime requirements, a broadening differential between peacetime and mobilization

requirements, and an increasing need to support humanitarian and disaster relief. DPSC has procured MREs since 1983 using a "modified systems approach." Under this approach, contracts are awarded to both prime assembly contractors and some suppliers of certain retort pouched entrees and support components. The suppliers' products are then furnished to the assembly contractors, who in turn incorporate the items into the finished MRE.

The Department believes it can provide MREs to its troops most cost-effectively by relying on a viable ration industry that derives a substantial portion of its income from commercial sales. For FY97 through FY99 procurements, DPSC will consolidate ration requirements (i.e., MREs, HDRs, HPMS, and other operational rations) into one acquisition ("integrated acquisition strategy"). The larger quantities will enable DPSC to negotiate the best price for these items and better manage MRE production capacity over a long period. The strategy also will provide the MRE industry with better information for planning purposes and incentives to concentrate on developing more commercial opportunities.

After the FY99 procurements, DPSC will evaluate the results and consider whether additional changes would lead to further overall MRE cost reductions. For example, under one approach being considered — a "total systems approach" — contracts would be awarded to one or more prime contractors, who would be responsible for furnishing the finished, assembled MRE, including all components, to the DPSC customer. The prime contractors would decide which components will be produced in-house and which will be obtained from outside sources. Factors DPSC plans to consider during the evaluation include the extent to which each strategy would: (1) encourage access to commercial products and processes, (2) increase competition, (3) reduce overall Department costs, and (4) sustain required surge capability.

In addition to developing new acquisition strategies, DPSC continues to improve business practices to more cost-effectively procure MREs. These business practices include: (1) awarding long-term contracts, (2) using best value source selection to evaluate proposals on competitive solicitations, (3) minimizing the use of military specifications in MRE procurement, and (4) issuing broad agency announcements to canvass industry for innovative approaches to meet operational ration requirements.

DPSC has developed several initiatives to maintain surge capability. DPSC incorporated surge option clauses in peacetime MRE contracts and established a planned producer production base with retorters and assemblers.<sup>1</sup> Additionally, DPSC has entered into shared production agreements with MRE suppliers and a commercial firm. Under this approach, the MRE supplier uses the same facilities to produce for both DoD and commercial customers in peacetime, but the facilities are to be dedicated to MRE production during mobilization or contingencies. Finally, DPSC has laid away specialized equipment used to manufacture meal bags, which is one of the pacing items to surge production.

The Department expects there will be sufficient industrial capability to meet its MRE procurement and technology development requirements for the foreseeable future. Additionally, DoD is taking steps to encourage its MRE suppliers to diversify into commercial markets. This will allow the Department to take advantage of the efficiency and innovations of the highly competitive commercial food processing industry, thereby reducing procurement costs while maintaining sufficient production capacity to meet mobilization requirements.

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<sup>1</sup> In return for contractor commitments to maintain production capability and capacity to meet military contingency requirements, DPSC restricts peacetime contracts for MRE retort items and assembly to planned producers. DPSC plans to integrate bakery firms into the planned producer program.

## 1.0 THE MEAL, READY-TO-EAT

### 1.1 Overview

The first U.S. Army ration was established by Congressional Resolution on November 4, 1775. Over the next two centuries, the ration design changed to accommodate demands for greater combat force mobility and dispersion, greater personnel acceptance, and convenience. The Department of Defense (DoD) uses the Meal, Ready-To-Eat (MRE) to provide troops with a nutritionally complete individual meal that is satisfying and packaged to endure harsh climates and rough handling. To meet mission needs, MREs have stringent shelf-life, configuration, nutritional, durability, and other requirements not usually available in commercial off-the-shelf or commercially developed products.

Four types of firms make up the top level of the MRE industry. *Retorters* process raw food ingredients into either entrees, fruits, or starches and then seal the items in flexible pouches. *Bakers* provide shelf-stable cakes, cookies, brownies, and breads specially formulated to meet military nutritional requirements. *Support component suppliers* furnish candy, beverages, hot sauce, crackers, jelly, cheese, and peanut butter spreads. *Assemblers* package all the MRE components into a meal bag according to the menu plan, and pack the meal bags into shipping cases that are palletized for shipment.

Key subtier suppliers include packaging firms and food (raw ingredients) suppliers. Packaging firms provide retort preformed pouches, material for accessory and support component pouches, and meal bags and shipping cases. Food suppliers provide raw ingredients such as uncooked meats, vegetables, fruits, spices, and starches to the retorters and bakers.

## 1.2 Evolution of Individual Rations

Armies have always supplied rations to individuals, small groups (a squad), and large groups (a company or larger). The need for an operational ration to feed troops operating away from fixed feeding facilities, and where supply lines are contested, was recognized as early as pre-Revolutionary War days, when the colonists' military action consisted principally of guerrilla warfare on both land and sea. During the Revolutionary War, the basic ration contained 1 pound of beef,  $\frac{3}{4}$  pound of pork or salt fish, 1 pound of flour, 3 pints of peas or beans, 1 pint of milk, 1 quart of beer or cider, bread, plus a group issue of candles and soap per week. The Civil War ration was little improved over the Revolutionary War ration, although coffee, tea, seasonings, and potatoes were added when practical.

In 1934, the U.S. Army introduced an individual ration consisting essentially of a meat hash, vegetables, and bread. The long supply lines and mobility of the forces during World War II led the Army to develop specially packaged rations to feed groups or individuals operating for varying periods away from or in advance of their field kitchens. The Combat (C) Ration met this need based on the relatively unchanged major objectives of ration development: (1) to meet military strategic and tactical requirements through shelf life and transportability, and (2) to maintain readiness through nutrition and acceptability.

The Meal, Combat Individual (MCI) replaced the C Ration after the outbreak of the Korean conflict, and was used during the Vietnam War through the early 1980s. The Vietnam War, where resupply was often precluded by weather and enemy activity, dramatically brought into focus the need to increase shelf life and reduce weight and volume. This was accomplished primarily by replacing the can used for the MCI with flexible packages.

The MRE, first produced in 1980 and distributed Army-wide in 1983, took advantage of the lessons learned in Vietnam:

- The MCI had an estimated shelf life of 24 months at 70 °F. The heat and humidity of Vietnam led to reduced shelf life, spoilage, and frequent and expensive MCI

replenishment. MREs have a shelf life of 66 months at 70 °F (or 36 months at 80 °F, or 12 months at 100 °F).

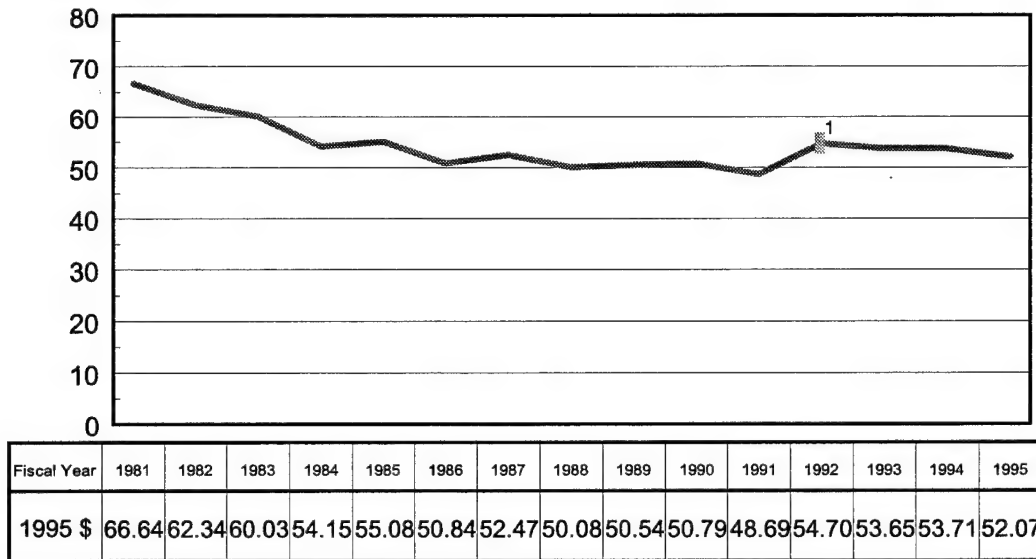
- MCI cans were relatively heavy and bulky, fit poorly in uniform pockets, and could injure a Service Member. MREs are lighter and employ flexible pouches that easily fit into uniform pockets. MRE pouches do not require a tool for opening, and have no sharp edges once opened. Additionally, MRE pouches are less expensive than the MCI cans.
- MCI cans corroded, reacted with the food, were difficult to dispose of, and were used by the enemy as booby traps. MRE pouches do not corrode, do not react with food, can be disposed of more readily, and have no secondary uses.

The MRE components and packaging/packing have gone through continuous product improvement based on customer feedback. The major thrusts have been to: (1) keep cost to a minimum without sacrificing quality; (2) maintain nutrition; (3) keep abreast of new and emerging packaging technologies; (4) meet the Military Services' desires for special or unique requirements, such as extended shelf life, lightweight packaging, and improved functionality; and (5) enhance troop acceptability in order to increase consumption.

Figure 1-1 summarizes the MRE procurement price since its inception. Between 1981 and 1995, the price has decreased by 22 percent in real terms — despite improvements in acceptability, nutrition, and durability. The cost increase in 1992 resulted from the addition of a heating device, previously provided through other supply sources.

**Figure 1-1. MRE Case Price**

1995 Constant \$ Per Case



<sup>1</sup> Flameless ration heater added to the MRE

Note: 12 meals per shipping case

Source: Defense Personnel Support Center (DPSC)

### 1.3 MRE Description

The MRE is a ready-to-eat meal containing quick-serve, precooked components which can be consumed in an austere environment. Components are acceptable eaten hot or cold. There is no preparation required except to add water to the beverage items. Packaging is lightweight and suitable for use without mess gear. Since the MRE is “thermostabilized,” refrigeration is not required.

All meals contain an entree, starch, crackers, a spread (cheese, peanut butter, or jelly), a dessert or snack, a dry beverage mix, an accessory packet, a plastic spoon, and a flameless ration heater (FRH). Table 1-1 lists the MREs produced in 1995 (individual menus change from year to year).

**Table 1-1. MRE Components (1995)**

MENU 1	MENU 2	MENU 3	MENU 4	MENU 5	MENU 6	MENU 7	MENU 8	MENU 9	MENU 10	MENU 11	MENU 12
Pork w/ rice in BBQ sauce	Chili w/ macaroni	Chicken stew	Grilled chicken	Spaghetti w/meat & sauce	Smoky franks	Beef stew	Ham slice	Pork chow mein	Tuna w/ noodles	Chicken w/rice	Escalloped potatoes w/ham
Applesauce <sup>1</sup>	Fruit <sup>2</sup>	Fruit <sup>3</sup>	Potato au gratin	—	Fruit <sup>3</sup>	—	Potato au gratin	Chow mein noodles	Fruit <sup>2</sup>	—	Applesauce <sup>1</sup>
Tavern nuts	Oatmeal cookie bar	Pound Cake	Pound Cake	Oatmeal cookie bar	Potato sticks	Cookie chocolate covered	Pound cake	Cookie chocolate covered	Pound cake	Fudge brownie	Fudge brownie
Peanut butter	Jelly	Jelly	Peanut butter	Jelly	Peanut butter	Cheese spread	Cheese spread	Peanut butter	Cheese spread	Cheese spread	Cheese spread
—	—	—	—	Candy <sup>4</sup>	Candy <sup>4</sup>	Candy <sup>4</sup>	—	Candy <sup>4</sup>	Candy <sup>4</sup>	Candy <sup>4</sup>	—
—	—	Cocoa	Cocoa	Cocoa	Cocoa	Cocoa	Cocoa	—	—	—	Cocoa
Beverage base	Beverage base	Sugar- free beverage	Sugar- free beverage	Sugar- free beverage	Sugar- free beverage	Sugar- free beverage	Sugar- free beverage	Beverage base	Beverage base	Beverage base	Sugar- free beverage
Packet A	Packet B	Packet A	Packet B	Packet A	Packet A	Packet A	Packet A	Packet A	Packet A	Packet A	Packet A

In addition to the listed components each menu contains crackers, hot sauce, a flameless ration heater, and a spoon. Accessory Packet A: coffee, cream substitute, sugar, salt, chewing gum, matches, toilet tissue, and a towelette. Accessory Packet B: coffee, cream substitute, sugar, salt, chewing gum, matches, toilet tissue, towelette, and candy (vanilla caramels, or Tootsie Rolls).

<sup>1</sup>Thermostabilized

<sup>2</sup>Freeze-dried fruit: peaches, pears, fruit mix, or strawberries (a minimum of two kinds must be used)

<sup>3</sup>Thermostabilized peaches, pears, pineapple, or mixed fruit

<sup>4</sup>Charms or heat-stable M&Ms

Source: DPSC

DoD also is acquiring Vegetarian MREs (VMREs). There are two VMREs — pasta primavera and cheese tortellini. Approximately 11,000 cases were purchased in 1995. VMREs will be integrated fully into the standard MRE menu in 1996. Additionally, the Department is procuring two religious rations (the Meal Religious Kosher and the Meal Religious Halal) — not part of the MRE family.

## 1.4 MREs and the National Military Strategy

The U.S. National Military Strategy concept of power projection and forward presence requires a flexible field feeding system that can be tailored to different tactical and logistical situations. The rations listed in Table 1-2 enable operational planners to establish a ration mix that is best suited



to meet mission, storage, and transportation capabilities; and war reserve requirements. The focus of this assessment is on the MRE. (Appendix A discusses the family of operational rations.)

**Table 1-2. Family of Operational Rations**

Type Ration	Feeding Level	Intensity of Conflict	Level of Preparation	Predominant Battlefield Location <sup>1</sup>	Advantages	Disadvantages
MRE	Individual	All	<ul style="list-style-type: none"> <li>• None</li> <li>• Flameless ration heater</li> </ul>	<ul style="list-style-type: none"> <li>• Forward</li> <li>• Remote</li> <li>• Fluid</li> </ul>	<ul style="list-style-type: none"> <li>• Ultimate flexibility</li> <li>• Meets nutrition requirements<sup>2</sup></li> <li>• Withstands environment</li> </ul>	<ul style="list-style-type: none"> <li>• Limited variety</li> <li>• 21-day consumption</li> <li>• Menu monotony<sup>3</sup></li> </ul>
Tray Pack Rations (UGR-H&S) <sup>4</sup>	Group	All	<ul style="list-style-type: none"> <li>• Minimal</li> <li>• Water heating 15-50 minutes</li> <li>• Trained cooks 1 hour</li> </ul>	<ul style="list-style-type: none"> <li>• Division</li> <li>• Corps</li> <li>• Echelons above Corps</li> </ul>	<ul style="list-style-type: none"> <li>• High flexibility</li> <li>• Limited sanitation</li> <li>• Meets nutrition requirements</li> <li>• Withstands environment</li> </ul>	<ul style="list-style-type: none"> <li>• Limited variety</li> <li>• Menu monotony</li> </ul>
B Rations (UGR-B)	Group	All	<ul style="list-style-type: none"> <li>• Extensive (no refrigeration)</li> <li>• Trained cooks 2-3 hours</li> </ul>	<ul style="list-style-type: none"> <li>• Division</li> <li>• Corps</li> <li>• Echelons above Corps</li> </ul>	<ul style="list-style-type: none"> <li>• Nearly A ration quality</li> <li>• High satisfaction</li> <li>• Meets nutrition requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Low flexibility</li> <li>• High preparation time</li> <li>• Additional transportation and cooks</li> </ul>
A Rations (UGR-A)	Group	Medium to low	<ul style="list-style-type: none"> <li>• Extensive (refrigeration)</li> <li>• Trained cooks 2-3 hours</li> </ul>	<ul style="list-style-type: none"> <li>• Division</li> <li>• Corps</li> <li>• Echelons above Corps</li> </ul>	<ul style="list-style-type: none"> <li>• Highly acceptable</li> <li>• Meets nutrition requirements</li> <li>• High variety</li> </ul>	<ul style="list-style-type: none"> <li>• Low flexibility</li> <li>• High preparation time</li> <li>• Additional transportation, refrigeration, and cooks</li> </ul>

<sup>1</sup> Division = forward combat troops, Corps = rear support troops, Echelons above Corps = support troops behind corps rear boundary.

<sup>2</sup> Operational rations must meet Military Recommended Dietary Allowances. See Appendix B for details.

<sup>3</sup> Menu expansion from 12 to 24 menus under way.

<sup>4</sup> Unitized group ration — heat and serve — modular ration concept integrates components of the A, B, and T rations with quick prepared commercial items, eliminating the need to order individual line items.

Source: U.S. Army Quartermaster Center and School.

As a theater of operations develops, the competition for transportation assets means that deploying forces initially may be confronted with limited logistics support. Consequently, the only source of subsistence available to the individual Service Member is what he or she can carry, i.e., a

basic combat load. Pre-positioned war reserve materiel stocks of MREs in the theater, in nearby ports, or afloat, reduce the demand on transportation assets.

As the theater matures and stabilizes, MREs supplement the feeding program in the rear areas and continue to provide the primary source of food for forward troops. Insufficient refrigeration, transportation, storage, and food service personnel hinder serving three hot meals every day, even in the rear areas. The flexibility of the MRE to be eaten anywhere, anytime, makes it useful to feed combat support personnel (e.g., truck drivers) who are away from their unit.

## **1.5 MRE Design Characteristics**

MRE design characteristics are based on an operational requirements document and subsequent mission needs statements. DoD's Food Nutrition Research and Engineering Board (FNREB) confirms, integrates, and prioritizes operational ration research efforts and individual MRE improvement activities based on the mission needs statements. The FNREB is chaired by the Director, Environmental and Life Sciences, Office of the Secretary of Defense, and includes the head of each Military Service's food program, plus a representative of the Defense Logistics Agency (DLA). As DoD's Executive Agent for Nutrition, the Army Surgeon General establishes MRE nutrient standards. The relationship between operational requirements and MRE design characteristics is summarized in Table 1-3, and discussed in the paragraphs immediately following the table.

**Table 1-3. MRE Design Characteristics**

Operational Requirement	Ration Design Characteristic
Prepositioned stocks	Extended shelf life (minimum 3 years at 80 °F)
Configuration	Not more than 1.5 lbs., fits into pocket, flexible pouch
Nutrition	Meets military recommended dietary allowance; provides required energy and nutrients
Durability & Reliability	Water, insect, and rodent resistant; markings legible; withstands temperature variation
Transportability	Withstands rough shipping and handling
Air Delivery	Parachute and free-fall drops
Acceptability	Service Members must eat and find satisfying
Special Characteristics	Resistant to nuclear, biological, and chemical contamination; and capable of being decontaminated

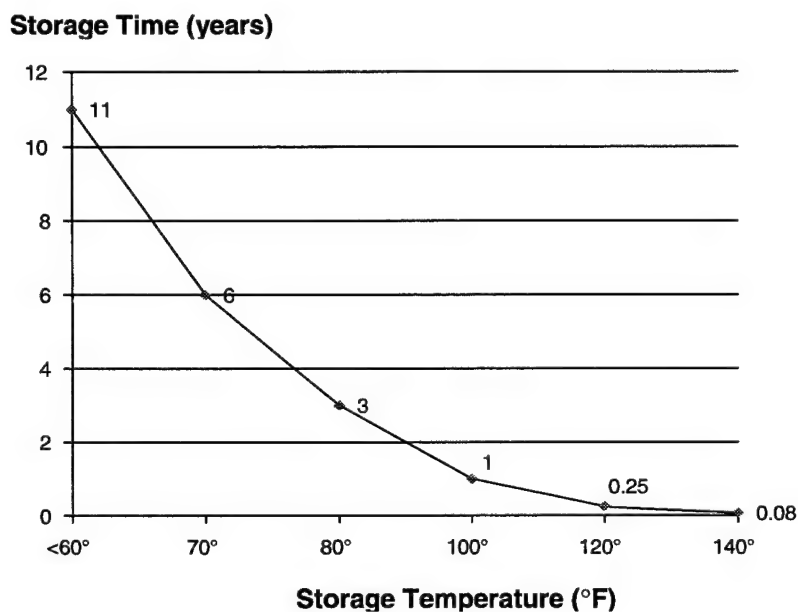
Source: Soldier Systems Command, Natick Research, Development and Engineering Center (SSCOM [NRDEC])

The necessity for extended shelf life is related to the need for pre-positioned stocks. Pre-positioned war reserve materiel stocks of MREs are employed to minimize transportation delays and to supply the deployed force until the MRE industry can ramp up production to meet wartime demand. The cost of the pre-positioned stock is directly related to shelf life. The shorter the shelf life, the more often the stock has to be rotated, and the higher the cost to maintain war reserves. For example, maintenance costs would increase by a factor of three to five, if the shelf life were reduced by 50 percent. The storage limit for food products is based on a time-temperature relationship; the higher the temperature, the shorter time the product remains edible. The shelf life of each MRE must meet the minimum time and temperature requirements shown in Figure 1-2.

To meet operational requirements, the MRE is packaged in flexible pouches compatible with the pockets of field clothing, and weighs less than 1.5 pounds. Weight and volume are minimized to ease the burden on the Service Member and reduce the number of aircraft and ships required for transport. MREs must also meet nutritional requirements more stringent than those required for commercial products, and must be nutritionally acceptable for consumption up to 21 days as a sole diet. Military recommended dietary allowances are greater than allowances specified by the National

Academy of Sciences for the population at large, because the typical Service Member using MREs is more physically active than his or her civilian counterpart. Each MRE provides an average of 1,300 calories. Calories for the total meal average 13 percent protein, 36 percent fat, and 51 percent carbohydrates. MREs are fortified with nutrients to meet these more stringent dietary requirements. (A detailed discussion of the nutritional requirements of operational rations is at Appendix B.) Finally, MREs must be assembled and packed to survive rough handling and air delivery — with and without parachutes.

**Figure 1-2. Predicted Shelf Life of MREs**



Source: SSCOM (NRDEC)

## **1.6 Industrial Capabilities**

The Defense Personnel Support Center (DPSC) is the program manager and systems integrator for the MRE acquisition program. The U.S. Soldier Systems Command, Natick Research, Development and Engineering Center (SSCOM [NRDEC]) is DoD's subsistence research and development center. NRDEC is responsible for establishing individual MRE menus to assure troop acceptance and nutritional content, and for improving the MRE. Retorters, assemblers, bakers, and

support component suppliers work together to produce the assembled MRE. Packaging and food suppliers provide packaging materials and raw food ingredients to the retorters, assemblers, bakers, and support component suppliers.

## ***DoD***

### **DPSC**

DPSC, as the program manager and system integrator, is responsible for MRE procurement and industrial assessment. DPSC, located in Philadelphia, PA, is a primary field activity of, and the subsistence inventory control point for, the Defense Logistics Agency (DLA). As an inventory control point, DPSC determines the annual procurement quantity of MREs and awards contracts to retorters, assemblers, bakers, and support component firms. Additionally, DPSC develops acquisition strategies to maintain the viability of the MRE producers and enhance their ability to meet mobilization requirements. DPSC is also responsible for MRE industrial capabilities assessment analyses and studies that are used to support acquisition strategy implementation.

### **SSCOM (NRDEC)**

SSCOM (NRDEC), located in Natick, MA, is the designated Executive Agent for the DoD Food Research, Development, Testing, and Engineering (RDT&E) Program, a coordinated program of applied research on food and food service systems for the Military Services and DLA. DoD Food RDT&E Program priorities are established by the joint service Food, Nutrition, Research and Engineering Board (FNREB).

### **USARIEM**

The U.S. Army Research Institute of Environmental Medicine (USARIEM), an element of the U.S. Army Medical Research Command, is collocated at SSCOM (NRDEC). USARIEM performs medical and physiological evaluations under all climatic conditions in support of DoD's food program. It performs human nutrition research on Service Members, testing new rations and nutritional supplements developed by SSCOM (NRDEC).

MRE improvement programs are developed based on customer feedback obtained through field surveys of operational forces and results of field evaluations of ration systems conducted by SSCOM (NRDEC) and USARIEM. New developed products and nondevelopmental items submitted by industry that meet ration design characteristics are submitted to the Joint Services Operational Rations Forum and the DoD Subsistence Review Committee for approval as MRE components.

### **VETCOM**

The U.S. Army Veterinary Command (VETCOM), headquartered in San Antonio, TX, is DoD's executive agent for Veterinary Services. VETCOM performs precontract award and postcontract award quality control system inspections, audits, and sanitary inspections of assembler and subcomponent manufacturer facilities. VETCOM also has inspectors stationed in assembler's plants to perform system and end item inspections to verify wholesomeness and quality provisions. (The U.S. Department of Agriculture inspects raw materials, and MRE processing and packaging operations.)

### ***First-Tier Suppliers***

#### **Retorters**

The retorters are food processors who take raw ingredients (meat, poultry, vegetables, fruits, spices, sauces, and broth) and prepare either the main entree, starch, or fruit item. The retorters place the prepared food items into flexible (preformed or form, fill and seal) pouches, seal the pouches using specially designed equipment, and then cook the items in a retort.<sup>1</sup> Retorting food in flexible pouches is identical to the process used in commercial canning.

Although MREs use a commercial retort cooking process, they differ from processing commercial food in two ways: MREs must be placed in flexible (preformed or form, fill, and seal) pouches, not cans, and the foods are specially formulated to meet military nutrition requirements.

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<sup>1</sup> A retort is a closed pressure vessel used to cook and thermostabilize the items, eliminating the need for refrigeration.

Specialized equipment and skilled personnel are required to fill and package food in flexible pouches. There are six retort firms in the MRE industry. Commercial sales represent about 45 percent of the total value of retort sales.

### **Bakers**

Bakers provide baked cakes, cookies, brownies, and bread specially formulated to meet military nutrient requirements. MRE bakery firms use the same type of preparation equipment and ovens used for commercial production. However, they also use specialized equipment to process and package military products. There are two bakery contractors in the MRE industry. Commercial sales represent about 25 percent of the total value of bakery sales.

### **Support Component Suppliers**

Support component suppliers furnish items such as candy, coffee, hot sauce, crackers, instant beverages, and various spreads. Support component suppliers ship material directly to the assemblers. DPSC provides these food components to the assemblers as government-furnished material. Twenty-one firms provide support components for MREs. Commercial sales account for the vast majority of the total value of component supplier sales.

### **Assemblers**

Assemblers bring together all the components that make up a finished MRE. The assemblers package the components in a meal bag according to the menu plan, pack 12 meals into each shipping case, and palletize the cases for final shipment. The assemblers are more than warehousing and distribution firms. They may have a food processing capability, and have designed special equipment to efficiently assemble and stuff the meal bag with components, seal the bags, and fill the cases. There are three MRE assemblers. DoD demand accounts for the vast majority of assembler sales. Commercial sales are virtually nonexistent.

## ***Second-Tier Suppliers***

### **Packaging**

Packaging suppliers provide military-specific packaging materials to the retorters, support component suppliers, and assemblers. They supply preformed pouches for use by the retorters; and rollstock for use by support component suppliers and for the assemblers to use as meal bags, accessory packets, and special MRE shipping cases. The packaging suppliers use materials specifically developed to meet requirements for durability in transit, storage, and field use; to withstand adverse climatic conditions; to survive airdrops; to resist insect and vermin infestation; and to meet shelf life requirements. The preformed pouches, menu bags, and raw materials for manufacturing packaging materials are the pacing items that restrict the maximum output of MREs. Six firms supply MRE packaging material. Commercial sales represent 96 to 99 percent of the value of packaging supplier sales.

### **Raw Food Ingredients**

Numerous suppliers provide uncooked meats, vegetables, fruits, spices, and starches for the MRE. The raw ingredients must meet USDA standards and specific nutritional and caloric requirements of the Military Services. Raw ingredients must equal or exceed USDA Grade A Standards. Commercial sales represent the vast majority of raw food material suppliers' business.

## **1.7 Commercial Products and Opportunities**

MREs utilize commercial food products, components, and processes to a great extent. However, military requirements preclude using commercially available products exclusively. Commercial consumers generally prefer fresh or frozen entrees to shelf-stable (thermostabilized) food products. This limits the opportunities for MRE sales in the commercial market.

### **Commercial Products and Processes in MREs**

MRE raw ingredients and support components are virtually all commercial products. SSCOM (NRDEC) works closely with industry to increase the number of commercial components that can be



incorporated into the MRE. Since 1993, about half of the 45 new items added to the MRE were items commercially developed as potential MRE components, or commercial off-the-shelf products. SSCOM (NRDEC), DPSC, and USDA are actively involved in converting combat ration military specifications to performance specifications.

Although MREs have successfully incorporated commercial support items, an attempt to replace the MRE with commercial products was less successful. During Operation Desert Storm, operational ration shortfalls necessitated the use of a substitute shelf-stable product (the Meal, Ordered Ready-to-Eat, or MORE) composed of entirely commercial products. DoD was able to gain considerable experience using a commercial product as an operational ration and was able to directly compare the MORE with the MRE (Table 1-4). The MORE generally cost more per serving than the MRE. More importantly, MORE menus did not meet minimum military nutrition standards for vitamins and minerals. This was due in part to a lack of fortification, which limited serving the MORE to no more than one meal per day. Milk, bread, fresh fruit, and salad had to be added to meet nutrition requirements.

**Table 1-4. Comparison of MORE and MRE Features**

Feature	MORE	MRE
Packaging	<ul style="list-style-type: none"> <li>• 10 oz tray configuration</li> <li>• Polymeric tray; flexible film barrier lid</li> </ul>	<ul style="list-style-type: none"> <li>• 8 oz trilaminate pouch</li> </ul>
Preparation	<ul style="list-style-type: none"> <li>• Microwavable; heat in hot water</li> </ul>	<ul style="list-style-type: none"> <li>• Flameless ration heater; hot water</li> </ul>
Cost for Entree	<ul style="list-style-type: none"> <li>• \$1.65 per entree</li> </ul>	<ul style="list-style-type: none"> <li>• \$1.51 per entree</li> </ul>
Cost for Meal	<ul style="list-style-type: none"> <li>• .18 (packaging)</li> <li>• \$5.06</li> </ul>	<ul style="list-style-type: none"> <li>• .10 to .12 (packaging)</li> <li>• \$4.34</li> </ul>
Retort Process	<ul style="list-style-type: none"> <li>• Thermally processed in a commercial retort (steam or hot water)</li> </ul>	<ul style="list-style-type: none"> <li>• Thermally processed in a commercial retort</li> </ul>
Menu	<ul style="list-style-type: none"> <li>• Mainly casserole items (pasta-based)</li> <li>• No breakfast items</li> <li>• Menu varies with market, but fewer entrees available than MRE</li> </ul>	<ul style="list-style-type: none"> <li>• 50% of meals contain whole muscle meat entrees (protein-based)</li> <li>• Limited breakfast items</li> <li>• Menu variety (12); future 18, 24</li> </ul>
Nutrition	<ul style="list-style-type: none"> <li>• Higher fat, less energy</li> <li>• Was supplemented by fortified drinks</li> </ul>	<ul style="list-style-type: none"> <li>• Meets military nutrition requirements</li> </ul>
Fortification	<ul style="list-style-type: none"> <li>• Not a commercial requirement</li> <li>• Standard commercial items</li> </ul>	<ul style="list-style-type: none"> <li>• Crackers, cheese, cocoa powder, peanut butter, and beverage base<sup>1</sup></li> </ul>
Market Trend	<ul style="list-style-type: none"> <li>• Frozen dinners</li> <li>• Sales for shelf-stable dinners have declined; high-volume year was 1992</li> </ul>	<ul style="list-style-type: none"> <li>• No significant commercial application</li> </ul>
Shelf Life	<ul style="list-style-type: none"> <li>• 18 months</li> </ul>	<ul style="list-style-type: none"> <li>• 3 years (5 years for cold storage)</li> </ul>
Freeze & Thawing	<ul style="list-style-type: none"> <li>• No experience. Most packages have a flat heat seal. Freezing will stress the seal area; thawing may open seal, causing contamination.</li> </ul>	<ul style="list-style-type: none"> <li>• Freeze-thaw proven to -25 °F</li> </ul>
Inventory	<ul style="list-style-type: none"> <li>• Just in time<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>• 4.6 million war reserve stock</li> </ul>

<sup>1</sup>MRE firms that supply support components purchase raw products (e.g., peanut butter, flour, and cheese) in bulk and further process the ingredients into the finished product. They also purchase a vitamin premix in accordance with military requirements and appropriate ratios. The fortification takes place during the blending and mixing of the bulk raw ingredients.

<sup>2</sup>Excess inventory stored by commercial food processors is determined by the product's shelf life, the number of times the product is rotated on the shelf at the point of sale, and the amount of product obligated to a customer. Because of the major advances in technology and logistics, the response time to customers has been dramatically improved. Industry associates costs with the number of times a product is moved. Just-in-time inventory practices in the commercial market reduce inventories to the most cost-effective levels.

Source: SSCOM (NRDEC)

The MORE was heavier and bulkier than the MRE. It lacked durability, transportability, and nuclear, biological, and chemical (NBC) resistance. DoD incurred extra transportation costs because of the added weight and volume of the MORE (Table 1-5).

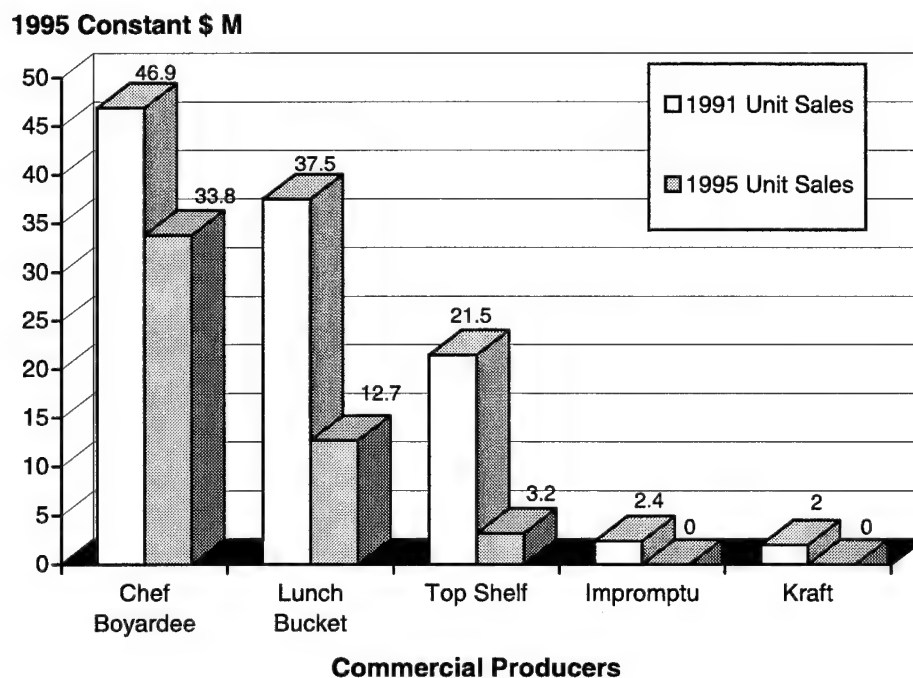
**Table 1-5. Comparison of MORE and MRE Transportation Requirements  
(1 million cases)**

MORE	MRE
3,472 pallets (40" x 48" pallet)	1,736 pallets (40" x 48" pallet)
193 each 20 ft containers	97 each 20 ft containers
25 C5A transport aircraft	12 C5A transport aircraft

Source: Headquarters Department of the Army, Office of the Deputy Chief of Staff for Logistics (HQDA, ODCSLOG)

Finally, the MORE, although composed of commercial components, was actually not a product of a broad, healthy, commercial industry. The MORE, like the MRE, is a thermostabilized meal. The commercial market for thermostabilized foods is declining (Figure 1-3), while the frozen food market is stable. In fact, two firms with thermostabilized sales in 1991 had no thermostabilized sales in 1995. Additionally, the Dial Corporation has announced it is ceasing production of its Lunch Bucket line.

**Figure 1-3. Thermostabilized Market — 1991 to 1995**



Source: SSCOM (NRDEC)

### **Commercial Opportunities for MREs**

Commercial customers generally prefer fresh or frozen entrees to shelf-stable food products. Competing commercial products include backpacking and camping foods. These foods are usually freeze-dried or shelf-stable entrees.

While the MRE has been used for humanitarian relief efforts, it is not an ideal ration for humanitarian feeding because of its high nutritional content. Humanitarian Daily Rations (HDRs) represent an emerging market in which MRE firms participate. The HDR was developed to support humanitarian relief feeding efforts in war-torn areas, and in areas of disaster or famine. It is designed to provide the minimal nutritional requirements for an undernourished person for one day. The use of a ready-to-eat ration permits emergency feeding as a stopgap measure when bulk food feeding is difficult or impossible. The HDR is designed to be sensitive to the ethnic and cultural needs of humanitarian feeding. It contains no meat or meat byproducts, has fewer components and less menu variety, and one meal bag feeds one person for one day. About 5.6 million HDRs have been produced since September 1993. DPSC has established indefinite delivery contracts to allow for quick reaction to future requirements.

The success of the HDR has led to demands for more ready-to-eat humanitarian relief rations, in particular the migrant camps established in Cuba and Panama. For example, 1.1 million HDRs were requested for use in migrant camps at Guantanamo Bay as a supplemental ration (rather than as a complete day's meal) during an unexpected influx of Cuban refugees. A modified HDR, the Humanitarian Pouched Meal (HPM), was developed to meet the refugees' particular needs; it includes a meat entree. Since October 1994, 3.6 million HPMs have been ordered.

With the expansion of humanitarian missions by DoD, the State Department, United Nations Forces, foreign governments, and nongovernmental organizations, the demand for humanitarian rations is expected to grow. Humanitarian rations are produced by the MRE industry on the same equipment as MREs. This helps to lower MRE costs (by absorbing a percentage of the overhead and administrative costs at the production facilities), contributes to the financial viability of the industry, and helps sustain the production capacity necessary to meet DoD mobilization requirements.

### **Commercial Opportunities for MRE Suppliers**

MRE retorters and bakers have facilities, equipment, and skilled personnel that allow the production of items other than MREs for commercial markets. Facilities and equipment — physical plant, batching and mixing equipment, ovens, retorts, packing and labeling equipment, and warehousing — are also used for commercial production. Skilled personnel — process engineers and technicians, quality assurance professionals, mechanics, foremen, and plant operations managers — can also be employed on commercial product lines. Retorters and bakers already produce portion-controlled, nutrient-controlled, and institutional items packaged in flexible pouches, microwavable bowls, trays, and cans for the commercial market.

Commercial sales for the retorters and bakers have remained relatively constant in the 1990s. However, commercial sales of specific shelf-stable and fresh pasta items, pizza, cookies, and sauces are increasing.

MRE assembly firms are totally reliant on military sales. The assemblers do have facilities and equipment that have commercial applications, such as third-party packaging or warehousing and distribution services. To date, however, none of the three firms have penetrated the commercial market.

## **2.0 DoD REQUIREMENTS**

### **2.1 Overview**

In 1941 the Berry Amendment required DoD to purchase food grown or produced within the United States, provided the food was of satisfactory quality, and was available in sufficient quantity, at market prices. The requirement has been enacted in permanent legislation [Section 9005 of Public Law 102-396, As Amended (10 U.S.C. 2241 Note)]. Consequently, only domestic sources have been used for MREs.

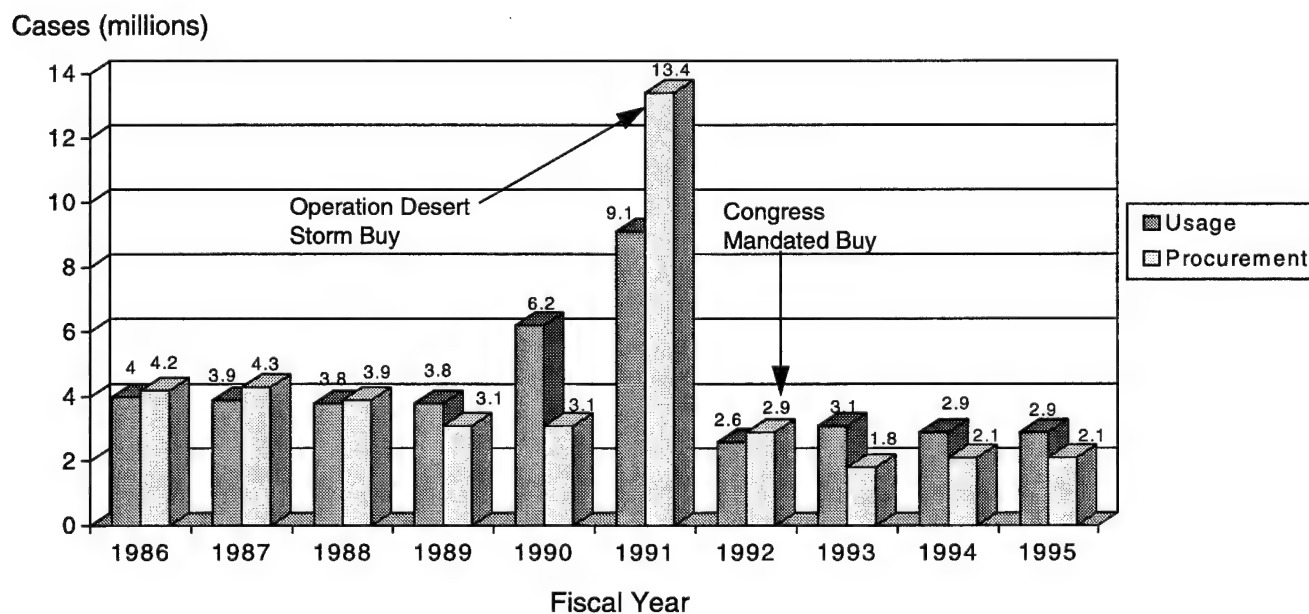
DoD requirements represent virtually all MRE demand. In peacetime, MREs are purchased in sufficient quantities to feed military combat personnel during training and contingency operations, and to be stored as pre-positioned war reserve stocks in various parts of the world. The war reserve stocks are rotated periodically to meet peacetime feeding needs and to maintain adequate quality. During the first 60 days of war, war reserve inventory is used almost exclusively until the MRE industry can surge its production to meet wartime (mobilization) requirements.

### **2.2 DoD Peacetime Procurement Requirements**

MRE usage levels are not equivalent to MRE procurement levels. In any given year, the MREs actually consumed were purchased and produced several years earlier and rotated through war reserve inventory. To avoid quality degradation during storage of any product or shortages in the war reserve inventory, the procurement quantity in a given year is calculated based on demand history, inventory levels, and input from the Military Services regarding proposed training and available funding. For example, if it is determined that the projected usage level, when combined with the current inventory level, will result in a shortage over a period of years, the procurement quantity will be adjusted to exceed the projected usage quantity for that year. Conversely, if it is determined that the projected usage and current inventory will result in excess inventory over a period of years, the procurement quantity will be reduced below the projected usage for that year. Today, the current inventory is 4.6 million cases, down from 6.5 million cases in 1989.

Figure 2-1 illustrates this process. It depicts historical MRE usage and procurement quantities. Recent peacetime usage of MREs is substantially less than usage in the late 1980s and vastly less than during Operation Desert Storm. Current peacetime usage (2.9 million cases annually, including foreign military sales) is 25 percent less than before Operation Desert Storm. Current procurement levels are 46 percent less than before Operation Desert Storm. For the past three years, procurement has averaged 32 percent less than usage, in order to reduce inventory, and because active-duty troop strength has been reduced from 2.2 million to 1.5 million and reserve strength from 1.2 million to 0.96 million since the end of the Cold War. Consequently, the authorized war reserve inventory level has decreased from 6.5 million cases to the current 4.6 million.

**Figure 2-1. Historical DoD MRE Usage and Procurement Levels**



Source: DPSC

MRE procurement quantities have leveled off since 1993 and are projected to be fairly stable through 1998 (Table 2-1). These procurements include foreign military sales (FMS). Opportunities for U.S. firms to export MREs have been limited. Within the past two years, however, FMS (primarily to Mexico and Kuwait) have increased significantly, from approximately \$375,000

annually in the late 1980s and early 1990s to \$3.4 million in FY94 and \$5.1 million (about 4.7 percent of total MRE sales) in FY95. FMS are expected to remain at these higher levels for the next several years. Planned procurements will support peacetime training and deployments and maintain the war reserve inventory.

**Table 2-1. MRE Procurements and Forecasted Procurements**

Year	Purchased Quantity (cases millions)	Dollar Value (1995 Constant \$ M)
1986	4.2	213.5
1987	4.3	225.6
1988	3.9	195.3
1989	3.1	156.7
1990	3.1	157.7
1991	13.4	652.5
1992	2.9	158.6
1993	1.8	96.6
1994	2.1	112.8
1995	2.1	109.3
1996	2.1	106.2
1997	2.4	117.8
1998	2.2	104.8

Note: 12 meals per case

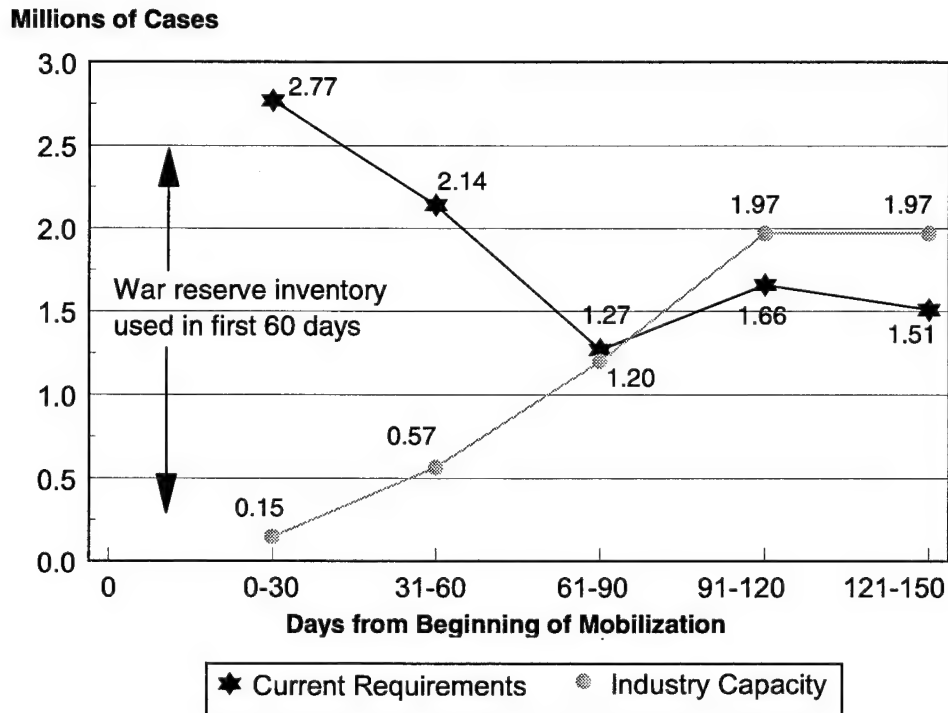
Source: DPSC

## 2.3 DoD Wartime (Mobilization) Requirements

DoD projects its mobilization MRE requirements to fight and win two nearly simultaneous major regional contingencies as 9.35 million cases — sufficient to feed 614,000 personnel — over 150 days, with a monthly maximum of 2.77 million cases in the first month. The Department recognizes that industry cannot meet mobilization requirements within the first 60 days and therefore relies on war reserve inventory stocks (4.6 million cases) until industry can surge its production. Figure 2-2 summarizes these requirements.



**Figure 2-2. DoD Mobilization Requirements**



Source: HQDA, ODCSLOG

## 2.4 DoD Technology Requirements

Funding for development of the next generation of rations and MRE improvements (summarized in Table 2-2) is provided through the DoD Food Research, Development, Testing, and Engineering Program in the 6.1 (research) through 6.4 (advanced development) programs. The 6.1 program involves the basic sciences to study the mechanism of changes in food and packaging systems at the molecular level. The 6.2 program, (exploratory research) applies the findings achieved through basic research to prototype new ration systems or improve existing ones. The new or improved ration technologies are demonstrated in field environments with operational forces under the 6.3 program (technology demonstration). After successful demonstration, the component or ration system transitions to the 6.4 program (advanced development) for user testing prior to adoption by the Military Services. From 1996 through 2000, DoD plans to spend a total of about \$22 million on operational ration research and development.

**Table 2-2. Operational Rations Research and Development Efforts  
(1995 Constant \$ M)**

Technology	Fiscal Year									
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
6.1 Research	0.34	0.43	0.38	0.31	0.24	0.18	0.18	0.18	0.20	0.30
6.2 Exploratory Research	2.49	2.64	2.37	3.21	2.50	2.82	1.48	1.15	2.30	3.55
6.3 Technology Demonstration	0.00	0.38	0.34	1.21	0.79	0.80	0.79	0.77	2.00	1.50
6.4 Advanced Development	1.30	1.06	0.84	0.98	1.60	0.59	0.80	0.86	0.55	0.75
Total	4.13	4.51	3.93	5.71	5.13	4.39	3.25	2.96	5.05	6.10

Source: SSCOM (NRDEC)

DoD ration science and technology research efforts include three main thrusts: (1) advancing performance enhancement and nutritional technologies to increase the Service Member's mental acuity, improve physical performance, reduce battlefield stress, and extend mission endurance in combat and environmental extremes; (2) developing preservation, stabilization, and packaging technologies to improve the stability of rations to withstand the rigors of long-term military storage and distribution worldwide; and (3) exploring innovative food processing technologies (i.e., ohmic heaters, microwave sterilization, intermediate moisture, and reduced thermal sterilization) to expand the variety of food components which can be incorporated into rations.

Scientific capabilities required to sustain these research areas include nutritional biochemistry, sensory physiology, neuropsychology, chemical engineering, and food science for nutritional performance enhancements; and packaging engineering, material science, behavior science, chemical engineering, and physical chemistry for preservation and stabilization technologies.

DoD must continually improve and update individual operational rations (MREs) to meet changes in battlefield requirements and doctrine. Therefore, between 1996 and 2000 about \$3 million of DoD's operational ration research and development budget is focused on the MRE:

**6.1 – Basic Research.** Research is being conducted on the microencapsulation of specific nutrients for oral consumption to improve nutritional quality and storage stability, and to enhance the Service Member's performance through improvements in nutrient bioavailability. The molecular

distribution of the water within food systems is being investigated to develop processes to improve the microbiological safety of the MRE.

**6.2 – Exploratory Research.** Efforts include development of oxygen-absorbing packaging materials to improve shelf life, development of mobility-enhancing MRE components to provide eat-on-the-move capabilities, and research to establish shelf life indices for the storage of MREs in environmental extremes (including arctic and desert storage). New analytical test methods are being developed using biosensors to rapidly detect quality degradation and microbiological contamination.

**6.3 – Technology Demonstration.** Technology demonstrations are being conducted under operational field scenarios to establish: (1) sensory acceptance of new or improved MRE components and packaging systems, (2) food stabilization technologies for storage in high heat environments, and (3) performance-enhancing ration components to extend the mental and physical capabilities of the individual.

**6.4 – Advanced Development.** Extensive advanced development studies are being conducted on fielded individual rations to improve the quality, reduce weight, minimize trash residuals, reduce cost through maximum use of commercial off-the-shelf items, and enhance nutritional quality through advanced technologies for increasing nutritional bioavailability. Composite packaging systems are being prototyped to reduce cost, improve shelf life, and lighten the Service Member's load.

As part of its MRE acquisition strategies, DoD also is developing advanced MRE production concepts and equipment designed to reduce overall costs. This effort is described in Section 5.2, "MRE Acquisition Strategies."

## **3.0 MRE SUPPLIERS**

### **3.1 Overview**

MRE industry sales, profitability, and employment levels have declined significantly from the peak demand during Operation Desert Storm in 1991. However, retort and assembly firm profitability levels continue to be comparable to those of their commercial counterparts. Bakery firm profitability lagged behind that of their commercial counterparts in 1994. DPSC is continuing to monitor the financial performance of the bakery firms to determine whether their ability to meet DoD requirements will be affected. DPSC did not analyze the financial performance of the support component, packaging material, and raw food ingredient suppliers because they are primarily commercial firms with limited military sales.

### **3.2 Suppliers**

The firms that form the MRE industry have varied manufacturing histories. Some previously produced canned rations, while others were entrepreneurs who went into business especially to produce MREs. One retorter and one baker were exclusively commercial firms that developed the capability to produce items for MREs. Raw food ingredient suppliers are commercially oriented firms. The firms currently producing MREs are listed in Table 3-1.

**Table 3-1. Firms in the MRE Industry**

Firm	Location	Size <sup>1</sup>	Industry
AmeriQual Foods, Inc.	Evansville, IN	Small	Retort
CINPAC, Inc.	Cincinnati, OH	Small	Retort
Land O'Frost	Lansing, IL	Large	Retort
Shelf Stable Foods, Inc.	Cincinnati, OH	Small	Retort
So-Pak-Co Packaging	Bennettsville, SC	Small	Retort
Star Food Processing, Inc.	San Antonio, TX	Small	Retort
Miss Kings Kitchen, Inc.	Sherman, TX	Small	Bakery
Sterling Foods, Inc.	San Antonio, TX	Small	Bakery
Ameripeac, Inc.	Buena Park, CA	Small	Components (peanut butter, jelly, cheese)
D.D. Bean & Sons, Inc.	Winston-Salem, NC	Small	Component (matches)
Diamond Crystal Specialty Foods, Inc.	Wilmington, MA	Small	Component (salt)
Domino Sugar Corp.	New York, NY	Large	Component (sugar)
Ford Gum & Machine Co., Inc.	Akron, NY	Small	Component (gum)
Interbake Foods Corp.	Richmond, VA	Small	Component (crackers)
Jianas Brothers Packaging, Co.	Kansas City, MO	Small	Components (beverage base, cocoa)
Lucas Confections, Inc. T/A The Classic Caramel Co.	York, PA	Small	Component (vanilla caramels)
M&M Mars, Inc.	Hackettstown, NJ	Large	Component (candy)
National Packaging Co.	Decatur, AL	Small	Component (cream)
Mark-Lynn Industries, Inc.	Bremen, GA	Small	Component (salt)
Nestle Brands Food Service Co.	Atlanta, GA	Large	Component (coffee)
Nice-Pak Products, Inc.	Orangeburg, NY	Large	Component (hand cleaner towelettes)
Rose Resnick Lighthouse for the Blind and Visually Impaired	San Francisco, CA	NIB <sup>2</sup>	Component (toilet tissue)
Royal Maid Association for the Blind, Inc.	Hazlehurst, MS	NIB	Component (spoons)
Stellar Industries, Inc.	Des Plaines, IL	Small	Component (beverage base)
ThermoPac, Inc.	Stone Mountain, GA	Small	Component (peanut butter, jelly, cheese)
Tootsie Roll Industries, Inc.	Chicago, IL	Large	Component (candy)
Trans-Packers Services Corp.	Brooklyn, NY	Small	Component (beverage base, cocoa, peanut butter)
Truetech, Inc.	Riverhead, NY	Small	Component (flameless ration heater)
Zesto Thermo, Inc.	Cincinnati, OH	Small	Component (flameless ration heater)
CINPAC, Inc.	Cincinnati, OH	Small	Assembly
Right Away Foods	McAllen, TX	Small	Assembly
So-Pak-Co. Packaging	Mullins, SC	Small	Assembly
American National Can Co.	Mount Vernon, OH	Large	Packaging
Cadillac Products, Inc.	Troy, MI	Large	Packaging (meal bags, accessory material)
Reynolds Metals Co.	Richmond, VA	Large	Packaging (pouch material)
Smurfit Flexible Packaging	Schaumburg, IL	Large	Packaging (pouch material, meal bags)
Gaylord Container Corp.	Bogalusa, LA	Large	Packaging (fiberboard)
International Paper Co.	Edinburg, TX	Large	Packaging (fiberboard)
Numerous			Raw Food

<sup>1</sup>A maximum of 1,000 employees are permitted for a firm in this industry to be considered a small business.

<sup>2</sup>National Industries for the Blind.

Source: DPSC

Under DPSC's Industrial Base Program, the MRE retort and assembly firms have entered into planned producer commitments with DPSC. Planned producers must demonstrate a capability to produce critical military items, provide production rate data to DPSC, and agree to maintain production capability and capacity to meet military contingency requirements. In return for contractor commitments to maintain production capability, DPSC restricts peacetime contracts for MRE retort items and assembly to planned producers. DPSC plans to incorporate bakery firms into this program. (See Section 5.6, "Planned Producer Commitments")

### **3.3 Financial Performance**

DPSC analyzed the financial performance of MRE retort, bakery, and assembly firms by evaluating historical sales, employment levels, return on assets (ROA), and operating profitability. (Refer to Appendix C for a further discussion of the data sources and methods used to evaluate financial performance.) Specific information pertaining to individual firms is not provided in this report, since that information is proprietary.

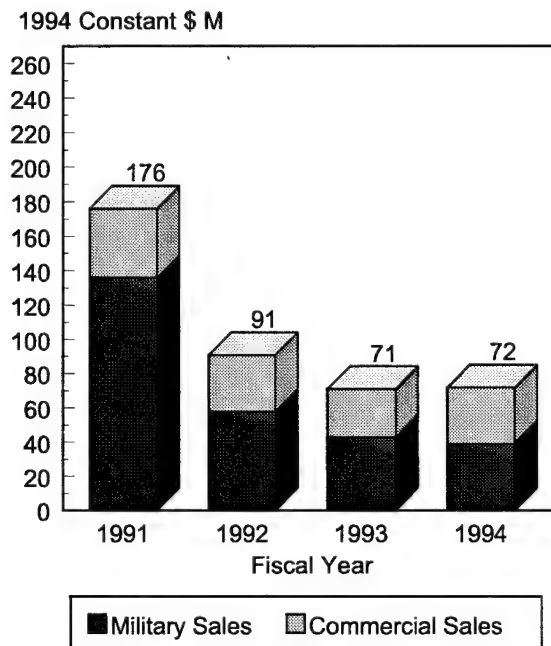
Declining sales, coupled with requirements to retain production capacity to meet DoD mobilization needs, have reduced ROA and operating profit margin since 1992. Nevertheless, profitability for most MRE firms continues to be comparable to that of the industry segment to which they belong.

MRE industry sales, profitability, and employment levels have declined from the peak production demand of Operation Desert Storm in 1991. Total sales for the retort, bakery, and assembly firms in 1991 were \$457 million, of which 87 percent (\$398 million) were military sales. In 1992, absent the effects of a major mobilization, total sales dropped to \$215 million, with military sales representing 84 percent of the total. By 1994 total industry sales declined to \$140 million, of which 74 percent were military sales. Total employment for the retort, bakery, and assembly firms has declined from approximately 2,300 employees in 1992 to 1,300 in 1994.

### Retort Firms

Total sales for the retort firms have decreased, due primarily to a decline in military sales (Figure 3-1). In 1992, retort firm sales were \$91 million, with military sales representing 64 percent of the total. By 1994 total sales had declined to \$72 million, a decrease of 21 percent. Military sales of MREs are expected to stabilize over the next few years.

**Figure 3-1. Retort Sales**

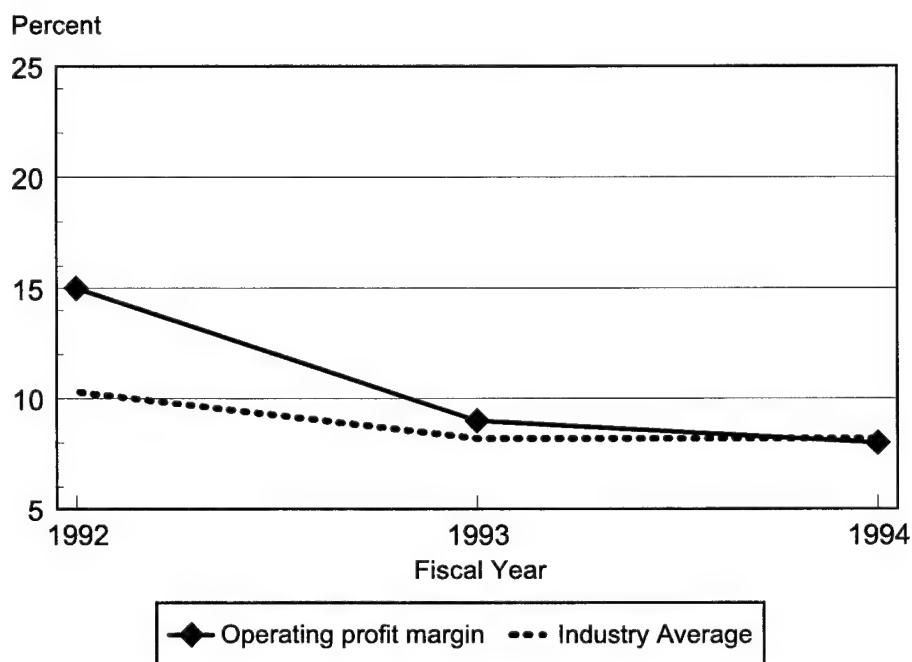


Source: DPSC

Commercial sales have fluctuated over the past four years, reaching a high of \$40 million in 1991 and a low of \$28 million in 1993. Commercial sales in 1994 represented 45 percent of total sales.

The operating profit margin for the retorters (Figure 3-2) decreased from 15 percent in 1992 to 8 percent in 1994, but is still comparable to that of similar, small commercial firms that manufacture prepared meat, fruit, and vegetable products. These commercial firms averaged 10 percent operating profit margin in 1992, and 8 percent in 1994.

**Figure 3-2. Retort Operating Profit Margin**



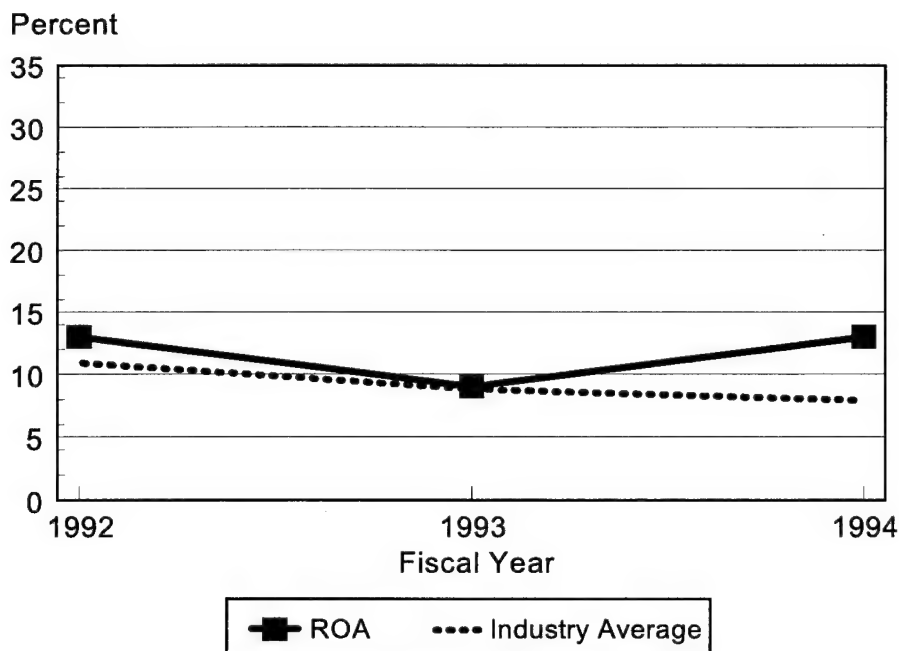
Note: The industry average was derived from "Manufactured Meat Products" (SIC 2013) and "Canned Fruits and Vegetables" (SIC 2030 and 2033) for those firms with less than \$120 million in annual sales, Standard and Poors Compustat, 1995.

Source: Defense Contract Audit Agency

Figure 3-3 depicts the ROA for retort firms during 1992 – 1994. ROA has remained stable at approximately 13 percent. Similar small commercial firms that manufacture prepared meat, fruit, and vegetable products experienced a decline in ROA from 11 percent in 1992 to 8 percent in 1994.



**Figure 3-3. Retort ROA**



Note: The industry average was derived from "Manufactured Meat Products" (SIC 2013) and "Canned Fruits and Vegetables" (SIC 2030 and 2033) for those firms with less than \$120 million in annual sales, Standard and Poors Compustat, 1995.

Source: Defense Contract Audit Agency

Retort firm employment levels declined 34 percent between 1992 and 1994. Retorters employed approximately 1,100 people in 1992, but only 725 in 1994.

### **Bakery Firms**

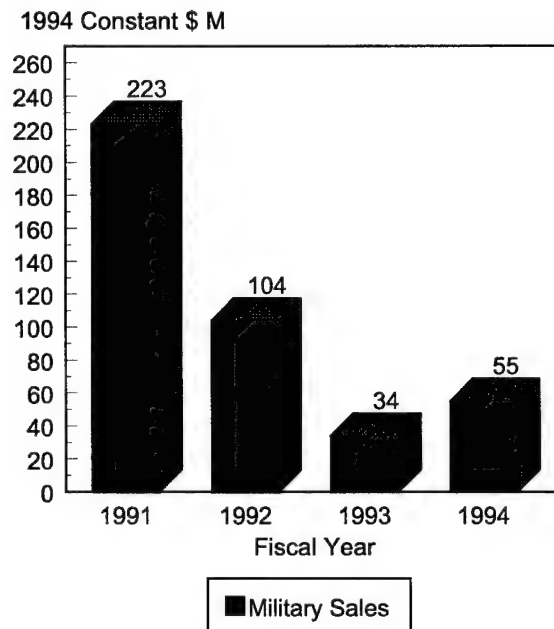
Since only two bakery firms supply MRE components, specific information pertaining to the overall financial performance of these firms cannot be presented in this report without divulging proprietary data. However, DoD did obtain and evaluate bakery firm financial information. Bakery firm profitability exceeded that of commercial bakery firms up until 1994, when ROA and operating profit margin declined to a level below that of other commercial bakery firms.

Commercial sales of the bakery firms have fluctuated over the past four years, reaching a high in 1991 and a low in 1993. Their 1994 commercial sales represented 25 percent of total sales.

### Assembly Firms

DoD demand accounts for all assembly firm sales. These sales have decreased substantially over the past few years due to declining military requirements. Figure 3-4 depicts 1991 through 1994 sales for the assembly firms. Sales were \$104 million in 1992, but dropped to \$55 million in 1994, a decrease of nearly 50 percent.

**Figure 3-4. Assembler Sales**

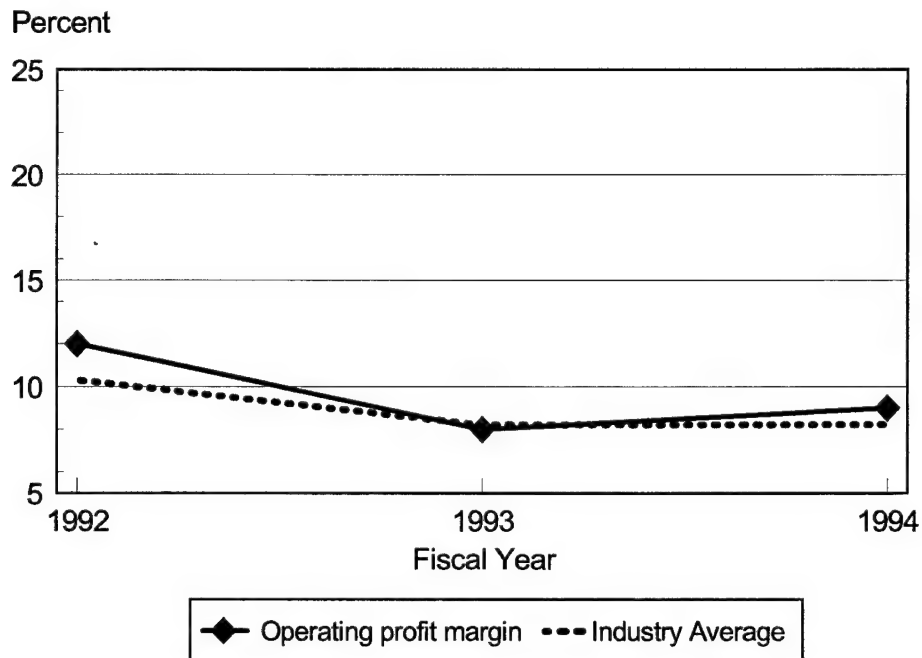


Note: There were no commercial sales.

Source: DPSC

Operating profit for assembly firms decreased from 12 percent in 1992 to 9 percent in 1994 (Figure 3-5). The operating profit margin for similar, small commercial firms that manufacture prepared meat, fruit, and vegetable products averaged 10 percent in 1992, and 8 percent in 1994.

**Figure 3-5. Assembler Operating Profit Margin**

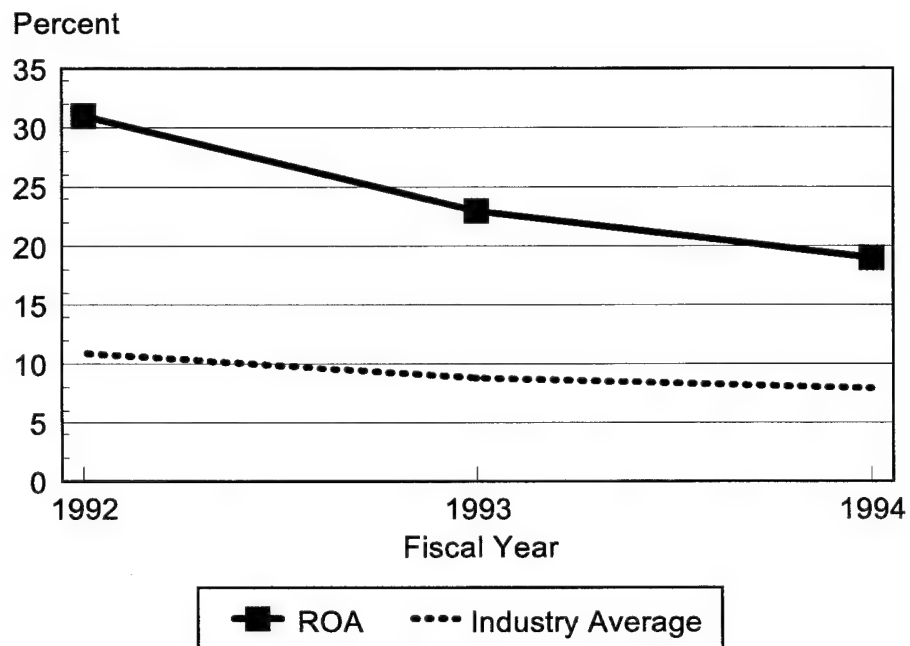


Note: The industry average was derived from "Manufactured Meat Products" (SIC 2013) and "Canned Fruits and Vegetables" (SIC 2030 and 2033) for those firms with less than \$120 million in annual sales, Standard and Poors Compustat, 1995.

Source: Defense Contract Audit Agency

In 1992, ROA for assembly firms averaged 31 percent but in 1994 decreased to 19 percent. ROA for similar, small commercial firms that manufacture prepared meat, fruit, and vegetable products averaged 11 percent in 1992 and 8 percent in 1994. Figure 3-6 depicts 1992 – 1994 ROA for the assembly firms.

**Figure 3-6. Assembler ROA**



Note: The industry average was derived from "Manufactured Meat Products" (SIC 2013) and "Canned Fruits and Vegetables" (SIC 2030 and 2033) for those firms with less than \$120 million in annual sales, Standard and Poors Compustat, 1995.

Source: Defense Contract Audit Agency

Employment levels for assembly firms have declined 60 percent — from 1,050 in 1992 to 425 in 1994.

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## **4.0 CAPABILITIES MEET DoD REQUIREMENTS**

### **4.1 Overview**

DoD MRE procurements, policies, and actions, coupled with war reserve inventories, are sufficient to meet projected peacetime and wartime requirements. The present capacity and surge capability of the MRE producers meet Joint Chiefs of Staff mobilization requirements, provided that current war reserve levels are maintained. DPSC is managing MRE procurements to ensure sufficient production capacity remains available to meet DoD requirements. Ongoing and planned operational ration and MRE technology development programs will ensure that the Department maintains the engineering and scientific capabilities required to continue improving MREs to meet evolving DoD requirements.

### **4.2 DoD Peacetime Requirements**

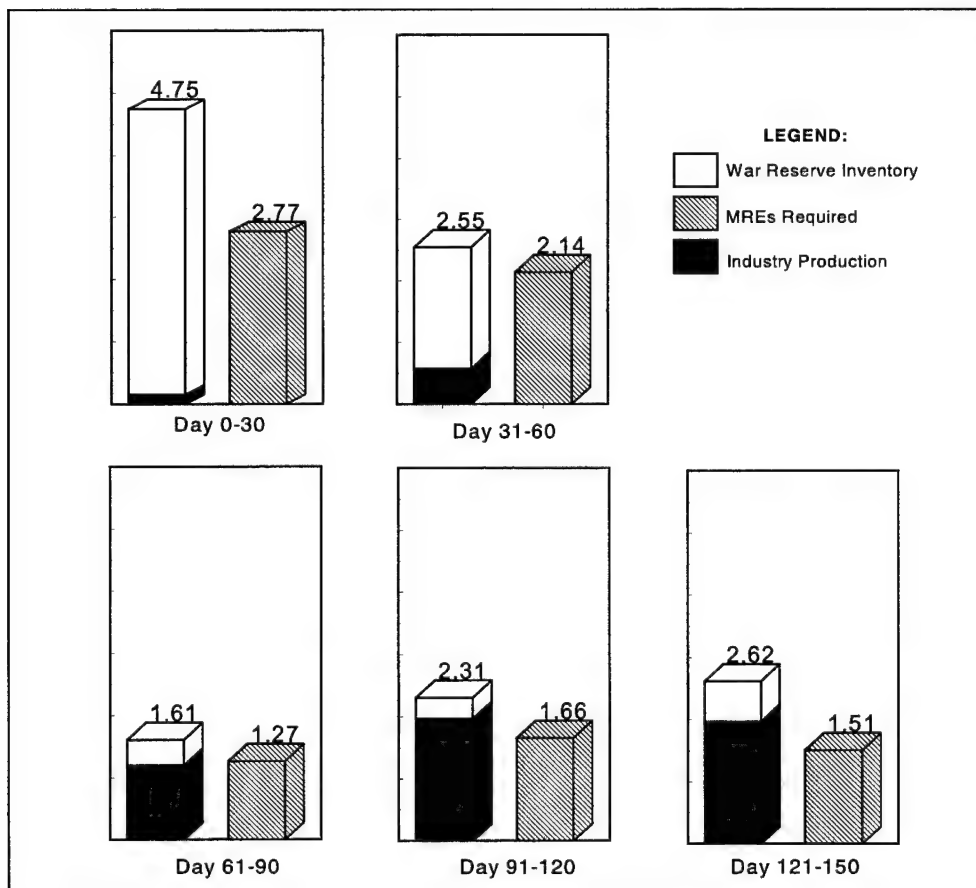
Industrial capabilities needed to meet peacetime defense requirements for MREs are substantially less than those required for mobilization. Ongoing and planned acquisitions, coupled with DoD actions to meet mobilization requirements (see Section 5), are adequate to sustain the industrial capability needed to meet peacetime MRE requirements. The production of Humanitarian Daily Rations and Humanitarian Pouched Meals also will contribute to the economic well-being of the industry, since both are produced by the same firms on the same equipment used for MREs.

### **4.3 DoD Wartime (Mobilization) Requirements**

Peacetime acquisitions plus industrial base program planning actions are sufficient to maintain the production capacity to meet DoD MRE wartime (mobilization) requirements. DoD recognizes that there is a shortfall in production capacity to meet mobilization requirements in the first 60 days. War reserve stocks fill this void until the industry can ramp up to the level required (Figure 4-1).

After approximately day 90 of mobilization, the MRE industry production capacity is projected to peak at 1.97 million cases per month. This is sufficient to sustain the mobilized force and begin replenishing war reserve stocks as theater demand declines. DoD does not encourage MRE producers to maintain production capacity in excess of that required to meet peacetime, mobilization, and replenishment requirements. (Appendix D discusses the methodology used to determine the industry's maximum MRE production capacity.)

**Figure 4-1. Industry Production and War Reserve  
Meet DoD Mobilization Requirements  
(millions of cases)**



Source: HQDA, ODCSLOG

DoD's MRE war reserve inventory requirement is approximately 4.6 million cases, of which 150,000 cases are stored in Europe, 1 million cases on pre-positioned ships, and 3.45 million cases in U.S. refrigerated warehouses. The MRE industry will be able to provide an additional 150,000 cases

in the first 30 days of a conflict. Therefore, a total of 4.75 million cases will be available within the first 30 days.

Table 4-1 summarizes the maximum production capacity of the MRE retort, bakery, assembly, and packaging material firms. (The availability of packaging material is the limiting factor in surging production during the first 90 days of the conflict.) The capacities of the support component and raw food suppliers, which provide some commercial items, exceed mobilization requirements, and therefore are not displayed.

**Table 4-1. MRE Surge Capacity**  
Monthly Maximum Production After 90-Day Ramp-Up  
(Cases of MREs)

Firms	Retort	Bakery	Assembly	Packaging (preformed pouches)	Packaging (meal bags)
Max. monthly production	3,000,000	2,000,000	4,808,000	1,970,000	3,200,000

Source: DPSC

#### **4.4 DoD Technology Requirements**

From 1996 through 2000, the Department plans to spend approximately \$22 million on food program research and development. Approximately \$3 million of the total is focused on improving the MRE. Under the overall direction of SSCOM (NRDEC), the Department is coordinating research activities with other government agencies, industry, and academia. In the near term, these activities will focus on improving sensory quality, nutrition, troop acceptance, and shelf life; and on reducing cost. In the long term, research focuses on nutritional enhancement to improve Service Member performance and on ration preservation and stability. These activities are required to meet evolving battlefield and doctrine requirements. They also will sustain a scientific and engineering capability sufficient to meet the Department's MRE improvement requirements into the foreseeable future.



## **4.5 Future Financial Viability of the MRE Industry**

Military sales are expected to be stable or increase slightly between 1995 and 1997. Additionally, there is a potential for the retort, bakery, and assembly firms to increase their commercial sales during this period. Stable or increasing sales will help lower costs. DPSC will continue to evaluate the progress of the bakery firms, and take action as necessary to ensure sufficient industrial capability is available to meet DoD MRE production requirements.

## **5.0 DoD POLICIES AND ACTIONS**

### **5.1 Overview**

DoD's goal is to meet its peacetime and mobilization MRE requirements cost-effectively by relying on a viable, competitive ration industry that derives a substantial portion of its income from commercial sales. However, MRE requirements cannot be met with a totally commercial product, and the MRE industry is dependent on DoD. Therefore, DPSC is developing acquisition strategies that encourage existing MRE suppliers to: (1) diversify into commercial markets, (2) take advantage of commercial products and processes, and (3) reduce costs and prices. Additionally, to help meet peacetime and mobilization requirements, MRE acquisition strategies consider required mobilization capacity, economic sustainment of the industry, and the need to maintain continuing production to provide a foundation from which to surge.

### **5.2 MRE Acquisition Strategies**

The current acquisition environment is characterized by increasing fiscal constraints, reduced peacetime requirements, and an increasing need to support humanitarian and disaster relief.

To meet these challenges, DPSC is changing its MRE acquisition strategy from the "modified systems approach" it has used since FY83 to an "integrated acquisition strategy." The integrated acquisition strategy is designed to maintain required wartime production capability and minimize industry turmoil and job loss, while encouraging MRE producers to diversify into commercial markets.

After evaluating the results of this new strategy, DPSC will determine whether additional changes could reduce overall MRE costs while continuing to meet mobilization requirements. For example, DPSC will consider the potential of utilizing a "total systems approach."

### ***Current — Modified Systems Approach***

Under a modified systems approach, contracts are awarded to prime assembly contractors. Additionally, DPSC procures some components (certain retort pouched entrees and support components) directly from suppliers and furnishes them to the assembly contractors. Assembly contractors incorporate all items into the finished MRE menus. The individual assemblers directly produce and/or directly procure components not provided by DPSC.

The modified systems approach has been used consistently since FY83, when the DoD Breakout Program was introduced to reduce product cost. The Competition in Contracting Act of 1984 provided further incentives to directly procure some components to enhance competition. This approach has enabled DPSC to reduce overall costs and maintain surge capabilities.

### ***Planned — Integrated Acquisition Strategy***

For procurements for FY97 through FY99, DPSC has planned an integrated acquisition strategy designed to consolidate DoD ration requirements into one acquisition. DPSC will combine the requirements for key operational rations programs (i.e., MREs, Humanitarian Daily Rations, Humanitarian Pouched Meals, and Tray Pack Rations) into one solicitation. (Many MRE firms also produce items for other operational rations). In the past, these rations were managed and acquired separately, resulting in multiple acquisitions from the same group of ration producers. Under the integrated acquisition strategy, the total three-year estimated requirements for operational ration items supplied by the operational ration industry will be solicited in a single acquisition. This should allow DPSC to negotiate the best prices for these items and better manage and maintain visibility over MRE industry capability over the long term.

The integrated strategy also provides the operational ration industry with known DoD business during this period, which should stabilize the industry's business base, and allow the industry to develop plans and strategies to expand into commercial markets. Performance matrices to measure the extent of commercial expansion will be incorporated into these

contracts and will be tied to future contracts to further encourage the MRE industry to pursue commercial sales.

DPSC issued a Request for Information (RFI) to the industry in September 1995 detailing DPSC's objectives and planned strategy and requesting comments or alternative approaches. Based on the responses, DPSC will develop the integrated acquisition plan, issue a formal solicitation, and make awards. Over the next three years DPSC will evaluate the integrated approach and determine whether further changes would be beneficial.

The integrated acquisition strategy is designed to:

- Streamline DPSC acquisition processes to improve lead-times, reduce administrative costs, and improve customer response time.
- Reduce overall long-term costs by allocating contractor overhead over a larger base (consisting of consolidated DoD business and planned increases in commercial business).
- Encourage MRE suppliers to decrease their dependence on military sales and increase their viability through active product development and increased commercial work, while maintaining surge capability to meet mobilization requirements.
- Measure diversification progress as reflected in their commercial customer base and implementation of innovative manufacturing techniques, inventory control, and distribution and transportation systems. Reward progress with follow-on contract awards.
- Encourage the utilization of state-of-the-art commercial packaging for operational rations and military packaging, if shelf life requirements can be met. Packaging is the key to MRE durability. Additionally, the preformed pouch is the limiting factor in the ability to surge MRE production.

- Utilize government-furnished equipment at contractors' facilities to help ensure surge capability and foster defense diversification.
- Identify the advantages and/or disadvantages of the modified systems approach. (The information will be used to determine if additional changes could reduce overall MRE costs while continuing to meet mobilization requirements.)

### ***Potential — Total Systems Approach***

DPSC will continue streamlining the acquisition process to reduce response times and costs. After the FY99 acquisition, DPSC will evaluate the benefits of the integrated approach and determine the feasibility of utilizing a total systems approach, or a hybrid of the two.

Under a total systems approach, multiple contracts would be awarded to one or more prime contractors, who would be responsible for furnishing the finished, assembled MRE, including all components, to the customer. The prime contractors would decide which components would be produced in-house and which would be obtained from outside sources. Under this strategy, DoD would rely on private industry to control costs and ensure both peacetime and mobilization requirements are met with quality and timely products. The intent would be to streamline the DoD acquisition process and reduce DoD infrastructure.

DoD is committed to employing an acquisition strategy that provides "best value." Therefore, DPSC will evaluate the results of the integrated acquisition strategy before adopting a total systems approach. DPSC will consider how much each strategy encourages access to commercial products and processes, increases effective competition, reduces overall Department costs, and sustains required surge capability.

## **5.3 Research and Development Efforts**

As discussed earlier, DoD is trying to reduce overall costs by encouraging its suppliers to diversify into commercial markets. Competitive commercial pressures would encourage innovation and help keep MRE prices down. One way DoD is encouraging diversification is

by developing advanced MRE manufacturing processes that can also be used to produce synergistic products for commercial markets.

### ***Combat Ration Advanced Manufacturing Technology Demonstration***

DoD's Defense Logistics Agency competitively awarded a contract to Rutgers University in 1988 for the Combat Ration Advanced Manufacturing Technology Demonstration (CRAMTD) program. The contract ends in May 1996. It provides for the development and demonstration of new technology to improve production efficiency and response times, and thereby reduce overall MRE costs. The CRAMTD program has four objectives: (1) to identify new or adapted existing equipment that could advance the industry through dual-use, state-of-the-art commercial technologies; (2) to improve overall product quality and in-process controls through the use of computer-integrated manufacturing; (3) to assist in marketing industry capabilities to potential commercial customers; and (4) to develop nontraditional capital investment criteria that take into consideration many long-range benefits (for example, to justify investment by quantifying the value of improved company reputation resulting from improved product quality). The contract also provides for industry participation through a coalition that would facilitate technology dissemination.

Under this contract, Rutgers University demonstrated "leak and weak seal detection equipment" and "horizontal form, fill, and seal equipment." (This equipment is being installed in retort firm facilities as described in Section 5.4.) Rutgers is also completing numerous short-term research and development projects designed to facilitate defense diversification, a material procurement system, and a vendor evaluation system.

### ***Combat Ration Network***

When the contract with Rutgers University expires, the effort will be restructured into the Combat Ration Network (CORANET), a partnership network with industry and academia. The CORANET research effort is intended to establish dual-use, end-to-end process capabilities by identifying and implementing targets for automation and business changes,

with the final goals being shorter lead-times, reduced inventory and overhead costs, improved quality, and increased commercial applications.

A broad agency announcement was issued in the *Commerce Business Daily* in October 1995 requesting proposals in combat ration manufacturing technology, including proposals for a demonstration site.

### ***Demonstration Site***

A demonstration site, will be used to conduct short-term research and development projects for DoD to help ensure that technology developed under CORANET can be transitioned to industry. The projects will include a broad spectrum of areas involving manufacturing of combat rations, such as packaged food design; equipment design; manufacturing; operation and maintenance; systems integration; and production planning, scheduling, and control.

## **5.4 Government-Furnished Equipment**

The retort process is the most important and difficult operation in MRE production. DoD has provided advanced production equipment to MRE retort firms to reduce costs and increase capacity.

### ***Leak and Weak Seal Detection Equipment***

DoD purchased leak and weak seal detection equipment in FY95 for the MRE retort contractors at an estimated cost of \$1.5 million. The detection equipment is designed to reduce the cost of inspecting flexible pouches for integrity defects, specifically leaks or weak seals, and also to reduce the costs associated with manufacturing nonconforming product. For example, the equipment can detect, within seconds, holes not visible to the human eye.

When the machine is strategically placed within a production operation, it becomes an effective quality assurance tool enabling rapid response to process defects, thus reducing the

quantity and cost of flawed products. In addition to reducing direct operating costs, the equipment avoids inventory buildup and rework costs associated with rejected product lots. The equipment directly affects production rates for both peacetime and surge.

### ***Horizontal Form, Fill, and Seal Equipment***

DoD programmed \$2.25 million in FY94 to buy horizontal form, fill, and seal (HFFS) packaging machines for the six retorters. The HFFS machines enhance the retorters' peacetime and wartime (mobilization) production capacity for whole, muscle meat entree items such as chicken breast and ham slices.

The current flexibly packaged and retorted MRE entree, starch, and fruit items are primarily casserole (pumpable) type food items. To enhance the acceptability of the MRE menu, the Military Services have recommended replacing some of these entrees with whole muscle meat (placeable) entrees such as chicken parmesan, grilled chicken, grilled beef steak, and turkey cutlet. DoD is considering increasing placeable items in 50 – 75 percent of the MRE menu. There is currently no efficient way to produce these placeable items in retortable pouches. The current casserole items use a vertical filling and sealing machine. When these placeable menu items are produced using current vertical pouch fill and seal equipment, machine rates drop 40 – 60 percent.

An emerging technology, the horizontal form, fill, and seal machine is a thermoform/pressure form packaging machine that can pouch placeable items without sacrificing line speed and overall production capacity. This type of equipment is widely used by commercial food processors to package products such as frankfurters, luncheon meats, pasta, frozen boil-in-bag items, cheese, or food products requiring a modified atmosphere package. DPSC will allow the MRE retort producers to use this government-furnished equipment for commercial production, thus helping the retort industry to diversify by targeting commercial customers through dual-use applications. The anticipated increase in commercial business should result in an overall cost savings to DoD, as a result of the allocation of overhead costs against the commercial quantities.



## **5.5 Business Practices**

In order to better meet customers' needs for the MRE in a cost-effective manner, DoD is continuing to re-engineer its business practices in the MRE acquisition process.

### ***Long-Term Contracting***

Long-term contracting provides for the award of contracts for supplies covering actual or anticipated requirements over one to five years. These contracts may take the form of indefinite delivery or indefinite quantity contracts, or they may incorporate option quantities.

Long-term contracting eliminates repetitive contractual actions and supports better contractor understanding of DoD peacetime and mobilization requirements. This provides both DoD and industry an opportunity to formulate long-term strategic business plans, stabilize requirements, and prepare for changing peacetime or mobilization requirements.

### ***Best Value Source Selection***

Best value source selection is a technique used to evaluate proposals on competitive solicitations by using evaluation factors in addition to price. This type of source selection is being used in MRE contract awards to select contractors that can best meet DoD needs for quality and timely supplies during peacetime and mobilization. DPSC has used past performance, quality assurance programs, manufacturing plans, and surge capacity as evaluation factors in addition to price.

### ***Commercial Practices***

DoD is committed to minimizing the use of defense-unique item descriptions (military specifications) in the acquisition process for defense requirements. The use of commercial item descriptions for the purchase of MRE commercial support components (e.g., candy and coffee) has increased significantly. The use of performance specifications for noncommercial

retort food entrees developed by the MRE industry has also increased. Military design specifications are used only for requirements for military-unique packaging.

### ***Broad Agency Announcements***

DPSC periodically issues broad agency announcements (BAAs) to canvass industry for innovative approaches to meet combat ration requirements, such as increasing diversification and commercial applications, and improving program management or production processes. The announcements are published in the *Commerce Business Daily*. Several concept papers submitted by the MRE industry in response to BAAs have resulted in shared production agreements that, in turn, have been incorporated into six contracts for MRE items. The contracts will test innovative concepts:

- Joint cost-sharing projects with industry and academia, to explore dual-use applications of MRE technology through demonstration programs for feeding the elderly and AIDS patients.
- Agreements between the MRE industry and commercial customers to relinquish commercial production capacity, to enable an MRE firm to fulfill DoD mobilization requirements, and to train employees on both commercial and DoD production lines to ensure continuous production.
- Development of electronic data interchange to enable acquisition documents (e.g., contracts, delivery orders, receipt, shipment, and payment data) to be electronically transmitted to improve communication and shorten lead-times.

## **5.6 Specific Actions to Maintain Surge/Mobilization Capabilities**

### ***MRE Industrial Capabilities Planning***

DPSC has implemented proactive strategies to ensure that domestic industrial capabilities are available to meet the peacetime and mobilization requirements of the Military

Services. DPSC has entered into planned producer commitments for retorted items and assembly with those firms needed to meet mobilization requirements. Further expansion of MRE production capacity is not likely unless the retort pouch (the pacing item in surging production) becomes commercially acceptable, or the technology used to manufacture these items is used for commercial ventures, thereby making it easier for commercial firms to enter the MRE business.

### ***Surge Option Clause***

The surge option clause is included in existing peacetime contracts with all MRE suppliers to ensure that, with a minimal contracting effort, a firm can accelerate to its maximum production capacity. Surge provisions allow the contracting officer to unilaterally increase a specific firm's production up to its maximum committed capacity.

### ***Planned Producer Commitments***

The six retorters and three assemblers have been designated as planned producers. This designation entitles these firms to be solicited for all acquisitions of retorted items and assembly, where applicable, for which competition is restricted to planned producers. Therefore, DPSC reserves the right to obtain these items from sources other than the commercial marketplace under contracting procedures for other than full and open competition. DPSC also plans to incorporate bakery firms into this program.

In return, these firms have agreed to update their production planning data, if changes in production capability or key subcontractors occur between regularly scheduled data updates, and provide more detailed data as required by DPSC; to accomplish subcontractor planning as required; to permit DoD personnel access to records, manufacturing process data, plants, and facilities in order to verify provided data; and to maintain surge capability set forth by the firm during active production of the items and for the period of two years after the completion of production, or for items not in current production (inactive items) for two years from the date the firm was made a planned producer. All activities undertaken by the contractor pursuant to the planned producer agreement, including the provision of any services that may benefit

DoD, are undertaken at the firm's expense and without cost to DoD, apart from any consideration promised by DoD.

### ***Shared Production Agreements***

DPSC has entered into shared production agreements (SPAs) with MRE suppliers and commercial firms whereby the MRE supplier uses the same facilities to produce both for DoD and the commercial customer during peacetime. The SPA stipulates the facilities are to be dedicated to military production during mobilization or other contingencies.

Contractors benefit by: (1) establishing long-term business relationships with commercial customers, as well as with DoD; (2) increasing their ability to rapidly respond to changes in customer demand; (3) having DoD encourage commercial customers to commit a portion of their business to DoD planned producers; (4) increasing their ability to meet surges in military demand without jeopardizing their relationship with their commercial customers; and (5) reducing allocated overhead costs, making the price of both commercial and defense products more competitive. DoD benefits include increased surge capacity and reduced prices for MREs and other operational rations.

To date, six SPA contracts have been awarded. Examples of shared production partners are: AmeriQual Food and Gerber, Inc.; Land O'Frost and Nutri-Systems; Shelf Stable Foods, AmWay, and TOSCORP; Star Food Processing, Inc., and Fagan & Smith; Nestle Brands Food Service Co., Vending Services of America, SYSCO Corp., and Keefe Coffee Co.

### ***Laying Away Government-Furnished Equipment***

Packaging materials used for MREs are the pacing items that determine the MRE industry's ability to meet mobilization requirements. Cadillac Products, Inc. purchased two four-die meal bag film lines to meet Operation Desert Storm requirements. Following Operation Desert Storm the additional capacity was not required for peacetime production. Rather than losing the surge capacity, DPSC acquired the two meal bag lines and laid these lines away so they would be available to meet mobilization requirements.

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## 6.0 CONCLUSIONS

- DoD uses the MRE to provide troops a nutritionally complete, individual meal in austere environments when no supporting cooks or group rations can be provided.
- The actual MRE ration has virtually no commercial market counterpart, since commercial products do not meet the stringent military shelf life, nutrition, and packing requirements. About half of the components in an MRE, however, do consist of commercially-developed food components.
- DPSC is employing innovative acquisition strategies and business practices to help lower the cost of MREs. These practices will increase contractor efficiencies and economies of scale, maintain effective competition, encourage MRE supplier diversification into commercial markets, and fund new technologies to improve production efficiency and response times.
- Between 1981 and 1995, the price for an MRE decreased 22 percent in real terms — despite improvements in acceptability, nutrition, and durability.
- MREs are “go-to-war” rations:
  - In peacetime, MREs feed military combat personnel during training and limited military operations, and serve as pre-positioned war reserve stocks.
  - During the first 60 days of mobilization, war reserve stocks are used almost exclusively until the MRE industry can surge production to meet significantly greater mobilization requirements.

- Purchases by DoD account for the majority of MRE retort, baker, and assembly firms' business. DoD must therefore ensure sufficient industrial capability is retained to meet its requirements.
- DoD MRE procurement requirements are projected to remain relatively stable, at about 2.1 million cases annually. MRE suppliers also produce related individual rations to support humanitarian relief missions.
- Ongoing and planned DoD operational ration technology programs are necessary to meet evolving battlefield and doctrine requirements. They also will sustain a scientific and engineering capability sufficient to meet the Department's MRE requirements for the foreseeable future.
- Production capabilities are sufficient to meet both peacetime and mobilization requirements:
  - Retort and assembly supplier profitability levels continue to be comparable to those of their commercial counterparts.
  - To ensure required production capabilities remain available, DPSC is monitoring those bakery suppliers that are less profitable than their commercial counterparts.
- DoD expects there will be sufficient industrial capability to meet its MRE requirements for the foreseeable future.

## **Appendix A**

### **Family of Operational Rations**



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## **APPENDIX A.**

### **FAMILY OF OPERATIONAL RATIONS**

#### **Family of Operational Rations**

The family of operational rations consists of A Rations, B Rations, Tray Pack Rations (T Rations), Unitized Group Rations (UGR-A, UGR-B, and UGR-Heat & Serve [H&S]), and packaged individual operational rations, which include the MRE. The MRE is described in detail in the main body of the assessment.

#### ***A Rations***

The A Ration includes a mix of perishable (fresh and frozen) and semiperishable (canned and packaged) items. Perishable items require refrigeration and have a short shelf life. The shelf life of the semiperishable items varies depending on the item. The food and packaging is fragile and susceptible to damage by extreme climates, weather, and pests.

The use of A Rations requires increased transportation assets and potable water. The workload and sanitation problems for food service personnel are increased. When perishable rations are introduced into an area of operations, refrigerated transportation and storage assets are required, both at subsistence issue points and at the preparation sites.

Preparing A Rations requires trained cooks and specific field feeding equipment found in the U.S. Army Mobile Kitchen Trailer (MKT), the U.S. Marine Corps (USMC) Field Kitchen, the U.S. Air Force (USAF) Bare Base Kitchen, and U.S. Navy ships. It takes 2 to 3 hours to prepare a meal for 300 persons. Additional personnel are needed for serving and sanitation. An average of 155 gallons of potable water per day is required to prepare food and beverages and perform sanitation for 300 persons. Normally, the A Ration is used in garrison, but it may also be used in the field if the tactical and logistical situation permits.

## ***B Rations***

The B Ration consists of semipерishable items such as canned and dehydrated meats, fish, poultry, fruits, and vegetables; bakery mixes, cereals, rice, and pasta; and condiments, dehydrated soups, and powdered beverage mixes. The components are packaged in bulk containers of various sizes and types. The shelf life varies depending on the item. The food and packaging is fragile and susceptible to damage by extreme climates, weather, and pests.

The B Ration is used in areas having trained cooks and specific field feeding equipment found in the U.S. Army MKT, the USMC Field Kitchen, and the USAF Bare Base Kitchen, and where the tactical and logistical situation permits group feeding. B Ration meals may be prepared when the theater stabilizes and resources are available.

It takes 2 to 3 hours to prepare a meal for 300 persons; additional personnel are needed for serving and sanitation. An average of 155 gallons of potable water per day is required to prepare food and beverages and perform sanitation for 300 persons.

## ***Tray Pack Rations***

The T Ration is designed to sustain the Armed Forces in highly mobile field situations with high-quality, nutritionally adequate heat-and-serve meals. The components are thermally processed, shelf-stable foods, packaged in hermetically sealed, half steam table-size metal containers. They include a variety of fully cooked tray pack entrees, vegetables, desserts, and starches. The container serves as a package, heating pan, and serving tray.

The ration is currently issued by individual line item or as a unitized group meal. The unitized T Rations are palletized separately by menu. Each pallet consists of 216 T Ration meals comprising 18-meal modules that include instant beverages and disposable cups, five-mess compartment trays, and utensils. The shelf life is a minimum of three years at 80 °F (27 °C).

T Rations are prepared by food service personnel, but offer the major advantage of requiring only heating, thus minimizing the need for equipment and sheltered work areas.

They can be heated, unopened, in boiling water for 15 – 50 minutes, depending on the product, or opened and heated in an oven to an internal temperature of 165 °F (75 °C). Another advantage of T Rations is that they can be heated, allowed to cool, and then reheated to be served. T Rations are heated using equipment available on the U.S. Army MKT, the U.S. Army Kitchen, Company Level, Field (KCLF), the USMC Field Kitchen, and the USAF Bare Base Kitchen. Use of the T Ration reduces food preparation time, water usage, and fuel compared to A or B Rations. However, T Rations must be supplemented with bread and milk.

### ***Unitized Group Rations***

The UGR is a modular ration concept for group feeding designed to streamline the logistics of field feeding at all echelons. It is based on the Army Field Feeding System-Future study approved by the Army Chief of Staff. The Army feeding standard was raised from one A or B type meal every two to three days to one A or B meal per day, tactical situation permitting. The USMC standard remains two A or B Ration type meals per day based on the tactical situation. The study revealed that operational deficiencies in food services, particularly the large volume of subsistence line items and the inability to manage subsistence supply, must be alleviated to meet this feeding standard.

The UGR concept was developed as a joint services research and development program at the Soldier Systems Command Natick Research, Development and Engineering Center to simplify and streamline the process of storing, ordering, transporting, and preparing meals in the field. The UGR integrates components of the A, B, and T Rations with quick-prepared commercial products, eliminating the need to order individual line items. The UGR has 5 breakfast and 10 lunch/dinner menus. Each of the menus lists an A, B, and T Ration entree. With the exception of A Ration perishable items, each menu is unitized into six boxes to feed 100 personnel. Meals will be unitized into three boxes to feed 50 personnel in future procurements.

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## **Appendix B**

### **Nutritional Requirements for Individual Rations**

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## **APPENDIX B.**

### **NUTRITIONAL REQUIREMENTS FOR INDIVIDUAL RATIONS**

The nutritional value of the operational ration has been a priority since World War II, when the need for rations was so urgent that a variety of rations had to be quickly formulated and shipped before development was completed. Since that time, ration development has been a continuous and planned process that has allowed the operational ration to meet changing military requirements while maintaining acceptability by the Service Member and meeting nutritional requirements. A ration not consumed provides no nutrition.

The primary purpose of military subsistence is to maintain the health and effectiveness of Service Members subsisted and consequently to enhance their combat readiness. It would appear that raw or perishable foods would be the best nutritional option, since foods lose essential nutrients during processing and preparation. However, the need for stockpiling, conservation of space and weight in storage and transport, and potential for worldwide distribution of the stored items precludes reliance on the refrigerated facilities and shorter shelf life products this would entail. In addition, during the early days of emergencies or deployments, refrigerated storage, food service facilities and food service personnel may not be available on a worldwide basis. The Meal, Ready-to-Eat (MRE) was designed to meet those military as well as nutritional requirements.

#### **A. Nutritional Allowances and Standards**

Military Recommended Dietary Allowances (MRDAs) are based on the National Academy of Sciences Recommended Dietary Allowances (RDA) as modified by military experience. The Food and Nutrition Board of the National Research Council assists the military in determining the MRDAs. Army Regulation 40-25, Nutritional Allowances, Standards and Education, defines the MRDA as the "daily essential nutrient intake levels presently considered to meet the known nutritional needs of practically all 17 to 50 year old, moderately active military personnel." The MRDAs are used by



professional personnel to plan menus, to evaluate diets on a population basis, to educate Service Members, to initiate research and development programs, and to improve rations. Derived from the MRDAs are nutrient standards that are the basis for evaluating the nutritional adequacy of operational rations. Nutrient Standards for Operational Rations (NSOR) are prescriptions for the nutrient content of operational rations. NSOR are minimal levels of select nutrients which must be provided in order to promote adequate nutritional intakes by the majority of military personnel engaged in moderate to heavy physical activity in the field.

As the Department of Defense's Executive Agent for Nutrition, the Army Surgeon General establishes NSOR, evaluates current and proposed changes, and recommends adjustments to ensure that the rations meet nutritional requirements for all personnel in all operational environments. This program is firmly grounded on nutritional studies conducted during actual military training and combat scenarios by the Soldier Systems Command Natick Research, Development and Engineering Center and the U.S. Army Research Institute of Environmental Medicine (USARIEM), and on recommendations by the Army Surgeon General regarding weight loss and inadequate intake of calories and selected nutrients.

Recommended Dietary Allowances (RDAs) are the levels of intake of essential nutrients that, on the basis of scientific knowledge, are judged by the Food and Nutrition Board to be adequate to meet the known nutrient needs of healthy persons. Energy allowances for adults are based on light to moderate activity. The typical Service Member is more physically active than his or her civilian counterpart, thus the military energy allowances for the Service Member are greater than the RDA. Thiamin, riboflavin, and niacin play an important role in the release of energy from carbohydrates, proteins and fats; and their dietary allowances increase as energy intakes increase. Because the military energy allowances are higher than the RDA, the MRDA table values (Table B-1) for thiamin, riboflavin, and niacin are also greater than the RDA table values.

For most nutrients, the NSOR are the same as their respective MRDA. For nutrients with allowances based on energy intake (thiamin, riboflavin, and niacin), the NSOR values are greater than their MRDA. Table B-1 provides a comparison of the most current RDA, MRDA, and NSOR values.

**Table B-1.****Comparison of Recommended Dietary Allowances, Military Recommended Dietary Allowances, and the Nutrient Standards for Operational Rations**

Nutrient	Unit	1989 RDA/Males	1985 MRDA/Males	NSOR
Energy	Calories	2,200 – 3,000 (age-dependent)	3,200 (2,800 – 3,600)	3,600
Protein	Gram	58 – 63	100	100
Vitamin A	µg RE	1,000	1,000	1,000
Vitamin D	µg	5 – 10	5 – 10	10
Vitamin E	mg TE	10	10	10
Ascorbic Acid	mg	60	60	60
Thiamin (B <sub>1</sub> )	mg	1.5	1.6	1.8
Riboflavin (B <sub>2</sub> )	mg	1.7 – 1.8	1.9	2.2
Niacin	mg NE	19 – 20	21	24
Vitamin B <sub>6</sub>	mg	2.0	2.2	2.2
Folate	µg	200	400	400
Vitamin B <sub>12</sub>	µg	2.0	3.0	3.0
Calcium	mg	800 – 1,200	800 – 1,200	800
Phosphorus	mg	800 – 1,200	800 – 1,200	800
Magnesium	mg	350 – 400	350 – 400	400
Iron	mg	10 – 12	10 – 18	18
Zinc	mg	15	15	15
Iodine	µg	150	150	none given
Potassium	mg	none given	none given	1,975 – 5,625

Source: Department of the Army, Office of the Surgeon General

**B. Nutrition Facts****1. Energy**

The NSOR energy requirement is 3,600 calories/day.<sup>1</sup> This requirement is based on Service Members participating in different activity levels:

- Moderate: 1.7 calories × REE (Resting Energy Expenditure) +/- 400 calories

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<sup>1</sup> National Research Council *Recommended Dietary Allowances* 10th Edition, 1989.

- Heavy:  $2.1 \text{ calories} \times \text{REE} \pm 400 \text{ calories}$

The REE of a median weight (78 kg) Service Member is 1,872 calories. Therefore,  $1.7 \text{ calories} \times 1,872$  plus or minus 400 is equal to 2,800 – 3,600 calories. Assuming activity levels in the field are moderate to heavy, the 3,600 calories would represent an average daily requirement.<sup>2</sup> MREs provide for the highest-need individual. This energy requirement has been verified in operational tests using Service Members.

## ***2. Breakdown of Calories***

Each MRE provides an average of 1300 calories (13 percent protein, 36 percent fat, and 51 percent carbohydrates). When supplemented with pouch bread, an additional 200 calories are provided.

## ***3. Fortification***

Some MRE components are fortified with select nutrients to compensate for the lack of sufficient quantities of fruits, vegetables, whole grains, and dairy products in the ration. These perishable items do not meet storage and space constraints and are not usually available upon initial deployment. In order to maximize the caloric density of the MRE and meet NSOR values, some of the ration components have been fortified with additional vitamins and minerals. This fortification allows the nutritional value to be substantially increased without increasing the ration weight, cube, and calorie content. Fortified components are defined in Table B-2.

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<sup>2</sup> U.S. Army Research Institute of Environmental Medicine.

**Table B-2. Fortified MRE Components**

Component	Fortification
Beverage base	Vitamin C
Cocoa beverage, cheese spread, and chocolate covered cookie, brownie	Vitamins A, C, B <sub>1</sub> , and B <sub>6</sub>
Peanut butter	Vitamins A, C, and B <sub>1</sub>
Crackers	Vitamins B <sub>1</sub> , B <sub>2</sub> , niacin, B <sub>6</sub> , and calcium
Oatmeal cookie	Iron
Jalapeno cheese spread and fruits	Vitamin C

Source: *Operational Rations, FY95*, Department of Defense Publication

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## **Appendix C**

### **Data Sources and Financial Analysis Methods**

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## **APPENDIX C.**

### **DATA SOURCES AND FINANCIAL ANALYSIS METHODS**

The Defense Personnel Support Center (DPSC) performed economic and financial studies on the Meal, Ready-to-Eat (MRE) retort, bakery, and assembly firms in 1992<sup>1</sup> and updated them in 1994. The studies evaluated eight years of quarterly production and financial data from each firm. DPSC representatives visited each firm to observe operations and to discuss and validate the data with contractor personnel as well as U.S. Department of Agriculture, and Department of Defense personnel assigned to the plant.

These studies of the MRE industry were continued in conjunction with an analysis of the industry's maximum production capability.<sup>2</sup> The economic and financial analysis considered peacetime production levels and the associated income needed to justify the amount of investment represented by the plant and equipment and thereby minimizing the risk of losing the firm's capability for mobilization. The production capability analysis provided the maximum output level or capability of each firm given the existing plant and equipment. The objectives of the studies were to determine and measure the following:

- The relationships between output levels (commercial and military), return on assets (ROA), and indirect unit cost
- The expected contribution of commercial production to total production
- The level of military production required along with expected commercial production to support a minimum return on assets of 5 percent.

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<sup>1</sup> Richard L. Cromley, "Minimum Sustaining Rate for MRE Producers," Operations Research and Economic Analysis Office, Office of Planning and Resource Management, Defense Personnel Support Center, Defense Logistics Agency, June 1992.

<sup>2</sup> Nancy Chester and Carmen Viola, "Maximum Production Capacity Study for MRE Assemblers and Retorters," Industrial Base Program, Defense Personnel Support Center, Defense Logistics Agency, June 1992.



The best measure of the financial viability of a firm is the degree to which it is profitable (i.e., making money). The primary measure of profitability for the purposes of this financial analysis is operating profit margin.

**Operating Profit Margin = Operating Income divided by Sales x 100 percent**

ROA presents another view of a company's financial health by gauging how efficiently the company's assets are being used to produce the product or service.

**ROA = Net Income divided by Total Assets x 100 percent**

## **Appendix D**

### **MRE Maximum Capacity Analysis**

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## **APPENDIX D.**

### **MRE MAXIMUM CAPACITY ANALYSIS**

The data collected from the Defense Personnel Support Center's (DPSC) 1992 industry study<sup>1</sup> is used as a point of reference for all subsequent maximum capability and capacity studies of the Meal, Ready-to-Eat (MRE) industry. The 1992 study is used as a benchmark to validate planned producers' production capability and capacity. When visiting a planned producer's facility, the production process is observed and unique processes and perspectives are obtained. On-site equipment is also verified for quantity, count, and operability.

Before planned producers' facilities are visited, each firm is requested by letter to provide pertinent data that can be reviewed ahead of time for subsequent verification during the plant visit. A June 29, 1995, letter sent to the MRE retorters and assemblers requested data for revalidation of the 1994 study. Firms were requested to supply information such as size of business, ownership, number of skilled and unskilled employees, previous verified maximum capacity and proposed changes, list of production equipment and production rates, manufacturing and supply line pacing factors, realistic ramp-up times, and subsector suppliers and commitment letters.

Data is verified during the plant visit by interviewing on-line managers and employees; timing production equipment in operation; reviewing the contractor's quality, production, and maintenance records; and interviewing on-site U.S. Department of Agriculture and U.S. Army Veterinary Inspection personnel.

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<sup>1</sup> Nancy Chester and Carmen Viola, "Maximum Production Capacity Study for MRE Assemblers and Retorters," Industrial Base Program, Defense Personnel Support Center, Defense Logistics Agency, June 1992.

After verification of the data, an adjusted estimated maximum monthly capacity is computed for each work center in the production process using the following general formulas:

$$1. \text{ Machine rate/minute} \times 60 \text{ minutes/hour} \times 20 \text{ hours/day} \times 30.4 \text{ days/month} \\ = \text{estimated pouches/month}$$

$$2. \text{ Estimated pouches/month} \times \% \text{ machine up time} \times \% \text{ conforming product} \\ = \text{adjusted estimated pouches/month}$$

By calculating the maximum monthly production capacity for each work center, the pacing work center can then be determined, which drives each firm's maximum capacity. This capacity is then compared with production records during Operation Desert Storm when each firm was at its peak production. The lower of the two figures is used as the firm's maximum production capacity. If no capital investments in equipment have been made, planned producers' production capacities will be the same as their peak during Operation Desert Storm. If production equipment has been purchased or sold, then the maximum capacity will be different. By comparing the computed production capacity with actual production records, intangible factors are considered, such as the hiring of new staff and the learning curve associated with training new employees. The results are discussed with the contractor, including a review of all pertinent data.